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EVALUATION OF A USER INFORMATION SATISFACTION SHORT-FORM INSTRUMENT

by

Mark S. Lockhart

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Co-Advisor: Moshe Zviran
Co-Advisor: Kishore Sengupta

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Evaluation of a User Information Satisfaction Short-Form Instrument

by

Mark S. Lockhart
Lieutenant Commander, Medical Services Corps
United States Navy
B.A., SUNY at Oneonta, 1974

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requirements for the degree of

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ABSTRACT

The objectives of this thesis were to validate and evaluate the Baroudi and Orlikowski [2] short-form UIS instrument as a surrogate measurement of effectiveness of the Department of Defense's Composite Health Care System (CHCS). Hurd [1], using the short-form UIS instrument at the Naval Hospital Charleston, suggested that a fundamental change in the instrument's structure due to significant impact of contractor's services with the CHCS. The three Navy CHCS operational testing and evaluation hospitals were used in this study.

The short-form UIS instrument was found to be inadequate for evaluation of overall UIS of the CHCS. Limitations found were: a fundamental change in the factor structure; unevenly distributed variables in a couple of factors; low reliability in one factor; no assessment of user interface with the system; and inconsistent convergent validity findings. A proposed re-design is presented.

Statistically significant differences in UIS between groups and sites were found for the four factor solution. Participants were divided into three functional user groups: Physicians, Medical Support, and Administrative Support. All three groups were satisfied with the local Management Information Department staff and services and the system's output. All three groups were dissatisfied with the contractor services. Physicians were significantly less satisfied in three out of the four factors. No significant correlation between time of use of the system and UIS was found, except for the Administrative group's positive correlation with the system's output.

TABLE OF CONTENTS

I. INTRODUCTION

Modern health care is becoming ever increasingly complex and costly in its delivery. The Department of Defense in its effort to combat these issues has put considerable effort and time into health care computer-based information systems. The latest system development underway is the Composite Health Care System (CHCS). This system integrates various health care components within the hospital-based health care catchment area.

Good management practices deem assessment of effectiveness of any implementation effort. Effectiveness of a computer-based information system can be defined as meeting the needs of the users it was intended to help. A commonly used assessment of system effectiveness used in the literature is the surrogate measure of user information satisfaction (UIS)--an empirical psychometric approach. Hurd [1] conducted an evaluation of UIS at the Naval Hospital Charleston, South Carolina--one of the Navy's three naval hospital operational testing and evaluation (OT&E) sites for CHCS. In his research, he used the UIS instrument and evaluation methodology developed and validated by Baroudi and Orlikowski [2]. The Baroudi and Orlikowski UIS instrument explained overall satisfaction to be the summation of each item (question) score which is the composition of three factors.

According to Baroudi and Orlikowski [2], the three factors that make up overall UIS are: 1) Electronic Data Processing (Management Information Department in naval hospitals) Staff and Services, 2) Information Product Output, and 3) User Knowledge and Involvement of the system. Hurd [1] separated the one factor dealing with Management Information Department staff and services into essentially two factors due to the fact that two of the questions dealt with services not provided internally--rather they are performed by an external vendor. This resulted in a four factor instrument, one that demonstrated the additional impact of contractor services on overall UIS in this setting. This fundamental change in the instrument's structure would tend to suggest invalidation of the overall UIS score, especially since the original instrument was specifically designed (content of the questions) to support the three factors mentioned above [2].

A. RESEARCH OBJECTIVES

The primary objective of this research is to evaluate and validate the Baroudi and Orlikowski UIS instrument (to be referred to as the short-form UIS instrument throughout this paper) using a particular setting and system--the CHCS at naval hospitals. Hurd's data will be included with the data collection samplings from the two other naval hospitals designated as CHCS OT&E sites. Questions to be answered are: 1) does the four factor (Management Information Department Staff and Services, Contractor Services, Information Product

Output, and User Knowledge and Involvement) exist using common factor-analytic techniques?; 2) is there equivalence (or invariance) of the four factor instrument across the three Navy CHCS OT&E sites?; and 3) using follow-up random interviews of system users, literature review, and empirical judgment, does the short-form UIS instrument adequately assess overall satisfaction?

Data collected from this research can be of additional informational value. Hurd's [1] findings indicated that 1) physicians were least satisfied with training; 2) physicians were least satisfied with understanding the system; 3) that all his designated user groups (physicians, ancillary support, and administration) were dissatisfied with the services provided by the contractor (i.e., handling and speed of implementation of system changes); and 4) there was no correlation between the length of time of system use and overall UIS score for all user groups.

Secondary objectives will be to evaluate the following: 1) do physicians significantly stand out as less satisfied as compared with other user groups?; 2) within user groups are there significant differences between location sites?; and 3) is there a correlation between length of time of use of the CHCS system and UIS?

B. OVERVIEW

Chapter II, discusses a brief review of the alternative measures of system effectiveness, some of the problems

associated with purely quantitative measures (i.e., economic analyses), and the development of the attitude psychometric instrument that is used in this study. Chapter III, discusses the research methodology used for the primary and secondary objectives, including a summary of the CHCS and the setting for this study. Chapter IV, presents the findings from the data collection, tabulation, and testing techniques employed. Chapter V, discusses the significant results and their impact towards the primary and secondary objectives. Lastly, Chapter VI, presents the conclusions derived from this study, as well as those issues for future research.

II. USER INFORMATION SATISFACTION AND ITS MEASUREMENT

A. INTRODUCTION

Computer-based information systems (CBIS) can be very expensive. As such, administrators and researchers have long attempted to identify a meaningful means to evaluate CBIS effectiveness. The most common approach suggested by Information Systems (IS) literature for measuring CBIS effectiveness has been user information satisfaction (UIS). Ives et al., define UIS as "the extent to which users believe the IS available to them meets their information requirements [3, p.785]." UIS is a perceptual or subjective "surrogate" measure of system effectiveness. Objective, quantitative measures, using economic analysis (i.e., cost-benefit determinations) have been reported to present problems in quantifying the actual benefits of a CBIS.

B. METHODS TO ASSESS EFFECTIVENESS

Generally speaking, measurement of CBIS effectiveness falls into two categories: economic and psychometric. Ideally, the CBIS's effectiveness or value to the organization would be evaluated using an objective economic analysis. The costs associated with the system operation would be subtracted from the actual benefits from using the system equated in monetary terms resulting in the net monetary valuation of effectiveness to the organization.

However, Ives et al., and many other researchers have argued that this is not a easy task due to: 1) difficulty to recognize and quantify intangible benefits; 2) certain benefits such as decision support ad hoc queries are virtually impossible to quantify; and 3) even when organization's attempt to quantify these items, they are usually highly subjective, and undocumented in how derived,or unavailable for research [1-10]. Approaches that have been advocated for measuring and improving CBIS effectiveness include usage estimation [11], incremental performance in decision making effectiveness [12], cost-benefit analysis [13], information economics [14], utility analysis [15], the analytic hierarchy approach [16], information attribute examination [17], and user information satisfaction.

A number of researchers have studied UIS as the measure of CBIS effectiveness [1-10] and [18-25]. Powers and Dickson [7], and Cerullo [25] suggest that user satisfaction (a psychometric measure) is the most important element in determining CBIS success. According to Conrath and Mignen [20], the key contribution in developing a tool for measuring and analyzing computer user satisfaction has been the research work of Bailey and Pearson.

C. DEVELOPMENT OF THE UIS QUESTIONNAIRE INSTRUMENT

Bailey and Pearson's [18] research involved a literature review of 22 studies of the computer/interface to establish an initial list of variables that might affect user satisfaction.

From the literature review, they identified 36 variables. Next, they had three data processing professionals review the list, wherein the list was expanded to 38 variables. The 38 variable list was empirically compared to interview responses from 32 managers of information systems in eight different organizations. After this interview process, one additional variable was added to the list for a total of 39 variables. Using the bidirectional model of Wanous and Lawler [26] which suggests that satisfaction is the sum of one's positive and negative reactions to a set of variables, and using semantic differential technique [27], Bailey and Pearson added dimensionality and intensity of an individual's reaction to each variable based on the use of adjectives to explain the user's perceptions. A seven interval Likert-type measurement scaling model was used to enumerate the adverbial qualifiers: extremely, quite, slightly, neither/equally, slightly, quite, and extremely for each of the negative to positive (bipolar) adjective pair. Each variable had four adjective pairs, one pair to rate satisfactory versus unsatisfactory, and one pair to rate whether the variable was important versus unimportant. The previously interviewed 32 managers were asked to fill out the questionnaire, with 29 being completed and returned. Although the sample size was small, Bailey and Pearson's instrument presented significant progress toward the development of a standard measure of UIS.[18]

Bailey and Pearson's [18] research instrument or construct for measuring UIS using their 39 variable questionnaire, set the stage for further research. They recommended further research and validation efforts in a wide variety of user environments, and the application of factor analysis to see if and when the list of variables can be reduced.

Ives, Olson, and Baroudi [3], chose to undertake a replication of Bailey and Pearson's findings to reinforce the validity of the instrument through further tests, and reduce the length of the instrument in an attempt to produce a standard "short-form" instrument. Their research was based on the completed questionnaires from 200 production managers in U.S. manufacturing organizations selected from a commercially obtained mailing list. From their research, the list of variables from the original Bailey and Pearson instrument were reduced to 22, and the four bipolar adjective pairs reduced to two pairs. Factor analysis testing was conducted on the 22 variable instrument to see if the information could be reduced into fewer latent variables (unobserved variables) or factors. Essentially, four factors were identified: Electronic Data Processing (EDP) Staff and Services, Information Product Output, User Knowledge and Involvement, and Vendor Support. Vendor Support was dropped due to only one variable loading into this factor, and the researcher's belief at the time that it was not a significant component to overall user information satisfaction

assessment. Their reliability, validity, and correlation data provided substantial evidence that the shortened form questionnaire is a sound general measure of Bailey and Pearson's original UIS concept.

Ives et al. [3], recommended further research to validate, extend, and disseminate the instrument. Additionally, they recommended a change in the instrument format. The original Bailey and Pearson [18] instrument, and the Ives, Olson, and Baroudi [3] instrument had each of the bipolar adjective pairs in the same directional format, scored negatively to the right, and scored positively to the left. Reliability would be further increased by mixing up the direction of some of the adjective pairs for some of the variables [3].

Baroudi and Orlikowski [2] further refined the short form of the UIS instrument previously researched by Ives et al. [3] into a 13 question (variable) measure of UIS. The 13 variables were selected because they believed the selected variables displayed the most desirable psychometric properties for the three UIS factors (EDP Staff and Services, Information Product Output, and User Knowledge and Involvement). One of the objectives of their study was to develop a standard "short-form" UIS instrument. As with the previous instruments, each bipolar adjective pair is scored using a seven interval Likert-type measurement scaling model with values ranging from -3 (extremely dissatisfied) to +3 (extremely satisfied), and zero indicating a neutral

response. Each variable (question) is scored by taking the average of the two bipolar adjective pair scores. They mixed up the direction of a number of the adjective pairs as recommended from previous research.

Baroudi and Orlikowski [2] specifically picked the variables in the short-form (Appendix A, Part B) that measured the three factors that Ives, Olson, and Baroudi [3] found to comprise overall UIS. Three subtotals representing the three factors were calculated by averaging the variables (questions) that comprised each (ranging from -3 to +3). Questions 1, 2, 6, 11, and 12 factor loaded in the assessment of the attitude and responsiveness of the EDP staff as well as the quality of the relationship between the user and the EDP staff for scoring the first factor. Questions 7, 8, 9, 10, and 13 factor loaded in the assessment of the quality of output delivered by the information system for the scoring of the second factor. Questions 3, 4, and 5 factor loaded in the assessment of the quality of training provided, understanding of the system, and participation in the system's development for scoring the third factor. The overall UIS score was determined by the summation of each of the 13 variable (question) scores. The total score could range from -39 to +39.

Data was collected from 368 employees, mostly clerical and support personnel, of 26 New York area organizations using transaction processing computer systems. Follow-up interview

measure of UIS from five of the organizations was conducted in addition to internal construct validity and reliability analysis. The data indicated that the interview assessments of user satisfaction or dissatisfaction correlated well with the satisfaction scores obtained by the short-form instrument and provides some evidence for the instrument's convergent validity.

Igbaria and Nachman [5] provided further validation of the Baroudi and Orlikowski short-form instrument in their study using a different sample of users. They performed a second order factor analysis to test for underlying homogeneity in the first order three factors that were extracted to assess overall UIS. Their results confirmed the homogeneity of the items and the appropriateness of combining the 13 questions as an overall measure of UIS. Additionally, they added a demographic section to the short-form instrument to assess the role that individual characteristics had with UIS. Based on previous research, they included computer experience, education, age, gender, organizational level, and time of use of computer system as user variables for UIS. From their research, they found that education, organizational level and gender were not correlated with UIS. However, their findings indicated a significant positive relationship between UIS and length of time using the CBIS.

Hurd [1] used the Baroudi and Orlikowski [2] short-form UIS instrument in his study of a specific CBIS (the Composite

Health Care System) at a particular site, the Naval Hospital Charleston, South Carolina. Hurd also used a demographic section with essentially the same salient user variables as Igbaria and Nachman [5], modified to meet the site under study (Appendix A, Part A). Hurd's findings suggested no correlation of overall UIS with time of system use. However, looking at the three groups of users (physicians, ancillary personnel, and administrators), Hurd noted that there were identifiable trends. Physician's overall UIS tended to remain essentially unchanged with time of system use. Administrators exhibited a positive trend, whereas the ancillary personnel exhibited a negative trend between UIS and time of system use.

The instrument used by Hurd (Appendix A) was utilized in this study to extend the study of CHCS user satisfaction at the two other CHCS OT&E naval hospitals for validation of the instrument, comparison, and time of use correlation testing.

III. RESEARCH METHODOLOGY

A. INTRODUCTION

This study has two main objectives. The primary objective is to evaluate the construct validity of the short-form UIS instrument. The second objective is a follow on from the primary objective. The findings from the currently used short-form UIS instrument will be presented and evaluated in light of the construct validity for user group/site UIS comparisons. In addition, the correlation between the length of time the user has used the CHCS and UIS will be evaluated. First, the sampling setting and participants will be discussed. This will also include a brief background about the CHCS. Next, the measurement scales used in this study will be presented along with the level of confidence used in the statistical analysis.

Validation of the short-form UIS instrument will take a series of progressive steps in order to answer the research questions. Although the three sampling sites are relatively the same (i.e., medium-sized naval hospitals), and could be assumed to represent a relatively homogenous sampling population, oneway analysis-of-variance (ANOVA) will be performed on the sampling demographics. Using the three site combined data, common factor analysis methods will be conducted. Common factor analysis is considered one of the

most powerful methods of construct validation as it allows the examination of the underlying structure of the overall measure [3][27]. Internal consistency or reliability testing of each factor as well as other statistical measures of overall factor structure "goodness of fit" will be used. Equivalence testing is conducted to test the invariance of the factor structure and loading across the three sites, and is important to demonstrate that there is no instrument bias. Lastly, responses from user interviews, and comments offered on the completed instruments will be used to look at convergent validity.

Evaluation of the findings from the short-form UIS instrument as mentioned above will rely on the outcome from validation. Presentation of the data will use statistical testing techniques to demonstrate differences in means between the defined user groups and sites. Correlation testing between length of time user use of the CHCS and UIS will also be evaluated. Correlation statistical methods will be used and tested for significance. Additionally, trend analysis will be conducted and presented.

B. SAMPLE AND DATA COLLECTION

1. Background of the Composite Health Care System (CHCS)

CHCS is a state-of-the-art, integrated, medical information system the Department of Defense (DoD) is testing for implementation at its medical treatment facilities. On the leading edge of technology and beyond the capabilities of

systems commercially available, CHCS is designed to improve the timeliness, availability, and quality of patient-care data. It will replace manual and automated information system now supporting DoD medical treatment facilities. At individual hospitals, it will integrate the functional work centers of inpatient and outpatient care facilities, patient administration, patient appointment and scheduling, nursing, laboratory, pharmacy, radiology, and clinical dietetics. CHCS is intended to provide physicians with immediate access to patient medical records. [28]

The approval of the Mission Elements Need Statement (MENS) in February 1979 affirmed the DoD's goal of providing integrated information support via a computerized system for its medical treatment facilities. A two-stage competitive acquisition process was undertaken to solicit industry's best solution to the needs of DoD medical treatment facilities. On September 10, 1986, stage I of the contract was awarded to four competing vendors. Each vendor was to design, develop, and implement levels I and II of CHCS (essentially outpatient services) at predesignated test sites. Stage II consisted of an extensive evaluation that included an extended benchmark test in order to aid in the selection of one of these vendors. Based on the evaluation, Science Applications International Corporation (SAIC) of San Diego, California was selected as the source to further develop and deploy CHCS to 12 operational testing and evaluation (OT&E or beta test)

sites. Of the 12 OT&E sites, three are Navy, five are Army, and four are Air Force medical treatment facilities. This group of OT&E sites represented hospitals with the number of beds ranging from 40 to 886, and outpatient clinic visits ranging from 247,285 to 1,573,369 per year. DoD estimates CHCS life-cycle costs (the expected life of the system is through fiscal year 2002) for full deployment to 767 medical treatment facilities at $1.6 billion.[1][28][29]

CHCS is a menu-driven, networked system, safeguarded via a password access hierarchal assignment according to the appropriate level of communication needs of the user. That is to say, that physicians as the focal point of health care and treatment are given the most authority to input and extract information from the system. CHCS also provides electronic mail communication and the system is intended to interface with other Hospital System Program Office (HSPO) and DoD initiatives including: food service, medical logistics, Defense Enrollment Eligibility Reporting System (DEERS), Medical Expense and Performance Reporting System (MEPRS), service-specific administrative systems, tactical automation systems, and National Disaster Medical System and Veterans Administration Systems.[29]

2. Sample and Data Collection

The three naval hospital OT&E sites (Charleston, South Carolina; Jacksonville, Florida; and Camp Lejeune, North Carolina) were evaluated in this study. Hurd's [1] data from

the Naval Hospital Charleston, South Carolina, was used in this study in lieu of re-sampling. The three sites are essentially the same size (medium-sized naval hospitals) with the number of hospital beds ranging from 170 to 184, and outpatient clinic visits ranging from 360,000 to about 570,000 per year [28]. No complete inpatient module implementation had occurred at any of these three naval hospitals at the time of data collection for study. Therefore, the nursing unit module was not evaluated. Additionally, the clinical dietetics module was not implemented. The modules that were implemented were: patient administration (PAD), patient appointment and scheduling (PAS), pharmacy (PHR), laboratory (LAB), and radiology (RAD). The PAD module was still being run in parallel with the AQCESS system, and did not have the cash collections component (MSA) on-line. The LAB module did not have the blood transfusion service component on line.

The short-form UIS instrument used was the same as that used by Hurd [1] due to the incorporation of his data from the Naval Hospital Charleston, South Carolina, into this study (refer to Appendix A). However, questions 8 and 10 were given further clarification using the definitions offered in the original study by Bailey and Pearson [18]. It was felt that there could be misunderstandings or ambiguity in interpretation by the subjects without this clarification, and would not jeopardize the instrument's integrity due to

both of these questions are expected to factor within the same factor (Information Product Output).

A data collection set consisted of a cover letter, the short-form UIS instrument, and an addressed envelope. The cover letter informed the subjects that their responses would be treated in complete confidentiality, and where to direct their sealed envelope response at each hospital. The Naval Hospital Camp Lejeune, North Carolina, and the Naval Hospital Jacksonville, Florida, were the two other Composite Health Care System (CHCS) facilities sampled. Prior to sending out the data collection sets to the Naval Hospital Camp Lejeune and the Naval Hospital Jacksonville, each facility's CHCS Project Officer was contacted to obtain their support and assistance in this study. Additionally, command notification and permission was obtained at each facility.

Each CHCS Project officer was sent 250 data collection sets. Additionally, general guidance for dissemination at each facility was provided to each CHCS Project Officer to ensure random sampling of all CHCS users in the outpatient areas (i.e., physicians, clinics, laboratory, radiology, pharmacy, and administrative departments). Returned instruments and Hurd's [1] Naval Hospital Charleston data were coded for responses and categorized into three functional groups: physicians, medical support, and administrative support. These groupings were different from Hurd's [1] study, however, these groupings

better represent the different user groups in terms of the function provided to health care, and therefore use of the CHCS. The physician group is self explanatory. The medical support group consisted of: nurses, pharmacists, technologists, other health care professionals, technicians, and hospital corpsman not working in an administrative department. The administrative support group consisted of: all administrators, secretarial and clerical persons regardless of department assigned to, and all other persons regardless of profession assigned to an administrative department. Education, sex, use of other computer systems, and use of other health care information system demographic information were given numerical values (i.e., male=1, female=2, no=0, yes=1, high school graduate=0, etc.) in order to allow comparative analysis using these attributes, or enable ease of database tabulation.

All responses were inputted using an integrated modular software package (Enable/OA). This package allows the researcher to build a database of responses and ease of data retrieval and importation of this data into a spreadsheet format for statistical analysis. Each of the questions (variables), factors, and overall satisfaction scores were computed as described by Baroudi and Orlikowski [2] (refer to Chapter II).

C. MEASUREMENT SCALES

In psychological or behavioral studies, there appears to be some confusion as to the legitimacy of using particular classes of mathematical procedures [8][27]. Specifically, the use of parametric statistical procedures verses nonparametric procedures with measures of psychological attributes. Parametric statistical procedures have more statistical power than nonparametric procedures, yet require at a minimum that there exists interval scales. According to Nunnally, an interval scale is "1) the rank-ordering of objects is known with respect to an attribute and 2) it is known how far apart the objects are from another with respect to the attribute, but 3) no information is available about the absolute magnitude of the attribute for any object" [27, p. 16]. Scaling models such as the seven interval Likert-type scaling model used with the short-form UIS instrument, are applied by the researcher to what appears to be ordered categories (or ordinal scales) to the subjects, to convert the data into interval scales. Nunnally [27] strongly believes that it is permissible to take seriously the intervals among scores in performing analyses of attitude such as that used with the short-form UIS instrument. It is beyond the scope of this paper to fully explain the rationale behind these arguments, and it is recommended that readers review Nunnally [27].

In this study, parametric procedures will be used, however, nonparametric procedures will be used in those cases

where testing failed to support the underlying assumptions for parametric procedures (specially, in the oneway ANOVA procedure). All testing was conducted at a confidence level of 95% or alpha = 0.05.

D. VALIDATION OF THE INSTRUMENT

1. Homogeneity of the Sample Data Sets

Oneway analysis-of-variance (ANOVA) using a PC version of MINITAB statistical program [30] and macro programs provided by Zehna [31] were performed on the following demographic attributes: education, age, gender, length of time (in months) of CHCS use, use of other computer system, and use of other health care information systems to ascertain homogeneity of the sample data sets. ANOVA methods have been developed to test for differences between the means of several groups. In this study, ANOVA procedures were applied to the three subpopulations: Charleston, Camp Lejeune, and Jacksonville. Where significant differences in means occurred, the Scheffe multiple comparison testing was conducted a posteriori. Additionally, a posteriori testing for normality and homogeneity of variance was conducted. Normality was tested using MINITAB's option for computing and storing fitted and residual values. Applying the NSCORE function to compute the normal scores of the residuals and then compute the correlation of the normal score with residuals approximates a normal distribution if the correlation is large (i.e., the closer to 1.0 the better)

[30]. The Hartley's Fmax test was used for homogeneity of variance.

2. Common Factor Analysis

The common factor-analytic model is different from principal components analysis in that it makes a distinction between common and specific parts of variables. In principal components analysis, the goal is to construct linear combinations of the original variables that account for a large part of the total variation. That is to say, the unobserved factors (latent variables) are expressed as functions of the observable variables, and is variance oriented, and without an error term. The common factor-analytic model, on the other hand, expresses each observable variable in terms of unobservable common factor and a unique factor, and is covariance oriented. The common variance of a variable is also called the communality of the variable. The communality of a variable is the portion of a variable's total variance that is accounted for by the common factors. With the principal components analysis there is no error term. Conceptually, the absence of an error term implies that the observable variables are measured without error and that the unobservable latent principal component is a perfect linear combination of its measures or are formative indicators of the unobservable factor. Whereas, common factor analysis is reflective in that the indicators subject to measurement error are a function of unobservables.

Instrument constructs to assess attitude are typically viewed as underlying factors that give rise to something that is observed, and therefore their indicators (i.e., the observed variables) should be viewed as reflective, hence the use of the common factor-analytic model. Common factor-analytic techniques can better serve the functions of searching the data for qualitative and quantitative distinctions and, especially testing a priori hypotheses and statistical testing criterion. [32]

The maximum-likelihood common factor analysis is preferred due to its ability to test hypotheses about the number of common factors. There are two different data analysis contexts: exploratory and confirmatory. Exploratory factor analysis is simply searching for a common structure underlying the data without having any theoretical hypothesis in mind. Whereas, confirmatory factor analysis there exists some prior theoretical information on the common structure underlying the data and one wishes to confirm or negate the hypothesized structure.[32][33]

The rotation process of factor analysis pattern matrix provides a clearer delineation of the pattern of relationships. Rotation options allow for a simple factor solution to become clearer. There are two methods in which the factor axes can be rotated. Orthogonal rotation preserves the original orientation between the factors so that they are still perpendicular after rotation. Whereas,

oblique rotation, the factor axes can be rotated independently. Varimax orthogonal rotation is one of the most popular rotation techniques used. Varimax rotation spreads variance evenly among factors while maintaining the original orientation between the factors so that they are still perpendicular after rotation. The procedure seeks to rotate factors so that the variation of the squared factor loadings for a given factor is made large.[32-34]

a. Exploratory Factor Analysis

Initially, exploratory factor analysis was undertaken using the SAS maximum-likelihood factor analysis procedure [33] on the combined data. Multivariate normality was assumed in conducting the exploratory factor analysis. Cattell's scree test was performed for determining the approximate number of factors to extract. The Cattell's scree test is simply a visual determination of the point where the factors curve above an approximate straight line made from the bottom roots [34]. SAS has the capability of computing the Kaiser-Meyer-Olkin (MSA option) measure of sampling adequacy [33]. The MSA is a summary of the extent to which the variables belong together and are thus appropriate for factor analysis [34]. MSA's greater than 0.8 can be considered good [33][34]. The Schwartz's Bayesian Criterion is used to determine the best number of factors to be extracted using the maximum likelihood factor analysis procedure. The number of factors that yields the smallest

value for the Schwartz's Bayesian Criterion is considered the best extraction [33]. The Schwartz's Bayesian Criterion according to the SAS user guide seems to be less inclined to include trivial factors than either the Akaike's Information Criterion or the chi-square test [33]. In the literature, there have been problems reported in using the chi-square test due to its susceptibility to sample size [35-38]. SAS also provides the Tucker and Lewis's Reliability Coefficient automatically for maximum-likelihood factor analysis procedure. The closer the Tucker and Lewis's Reliability Coefficient is to 1.0 the better the factor solution fit. SAS also automatically computes the squared canonical correlation (which is the same as squared multiple correlations) for maximum-likelihood factor analysis procedure. The squared multiple correlation (SMC) for each variable is the relative variance in that variable which is accounted for by the overall factor solution jointly [33][39]. Basically, the SMC represents the lower bound of reliability that each variable contributes to the overall factor structure. The maximum-likelihood factor analysis procedure because it is an iterative process using SMCs for initial estimates (using SAS) is susceptible to quasi- or ultra-Heywood cases. It is beyond the scope here to discuss these anomalies, however, SAS has a Heywood option which sets to 1 any communality greater than 1, allowing iterations to proceed until convergence criterion is met [33]. The Varimax

rotation option was used in the SAS procedure program. Lastly, the data was standardized using the SAS procedure STANDARD and retested using the maximum-likelihood procedure as above. Appendix B provides the SAS commands used for the exploratory factor analysis.

b. Confirmatory Factor Analysis

After obtaining the optimal factor structure solution via exploratory factor analysis, confirmatory factor analysis was conducted. This time multivariate normality was not assumed and the observed variables were analyzed for goodness of fit to the optimal exploratory factor analysis model using Jöreskog and Sörbom's LISREL 7 (Linear Structural Relations) computer program. The LISREL model can be viewed in terms of a confirmatory factor analytic model [32]. Jöreskog and Sörbom [39] in their LISREL 7 manual provide testing cases for non-normality where the observed variables are on interval scales using Weighted Least Squares analysis. Using Jöreskog and Sörbom's [40] PRELIS program, the raw data is converted and saved as a polychoric correlation matrix and an asymptotic covariance matrix to be used in the confirmatory factor analysis [39][40]. Appendix C provides the PRELIS commands used and the LISREL commands used for confirmatory factor analysis. In addition to the Total Coefficient of Determination (TCD), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), and Root Mean Square Residual (RMR), the output will provide the Standard Errors (SE), and

t-values (TV). LISREL's t-values or critical ratios when larger than two are normally judged to be significantly different from zero, and therefore indicating a true parameter for loading in that factor [39]. The TCD is a measure of how well the variables jointly serve as measurement instruments for the overall factor structure. The closer to 1.0 the TCD, GFI, and AGFI are, the better the model fits the data. The RMR and SE's should all be very small to indicate overall good fit of the data. There is some debate about the use of the GFI. Mulaik et al. [35], in a recent evaluation recommends the use of GFI when one has samples at least 200 in size, and of course when the conditions for that method are satisfied.

3. Reliability (Internal Consistency) Testing

Internal consistency was tested for each factor using Cronbach's Alpha reliability coefficient option in SAS's correlation procedure [41]. Cronbach's Alpha is based on the average correlation of items within a factor (or test). It represents the correlation between this factor (or test) and all other possible factors (or tests) containing the same number of items, which could be constructed from a hypothetical universe of items that measure the characteristic of interest (i.e., the factor). It also sets an upper limit to the reliability of the factor. If it proves to be very low, either the factor has too few items or the items have very little in common [27]. According to

Nunnally [27], reliability coefficients of .70 or higher will suffice in the early stages of research, and for basic research, efforts to increase much beyond .80 is often a waste of time and funds. Appendix D provides the SAS commands used to obtain the Cronbach Alpha's for each factor.

4. Testing for Measurement and Structure Invariance

Having conducted common factor analysis on the data as a whole, the next verification is to test that the factor structure and loading are the same for each of the three subpopulations. In addition, before conducting ANOVA testing of the three subpopulation location's for evaluating the difference in means, it is important to confirm that the measurement and the structure of the instrument designed to measure attitudes are equivalent across the subpopulations [37][38][42]. Jöreskog and Sörbom [39] provide a methodology to analyze data from samples simultaneously using their LISREL models. They outline a series of tests to be conducted to confirm measurement and structural invariance. The first test (hypothesis A) is an overall test of the equality of covariance matrices (or structures) across the three subpopulations. Failure to reject the null hypothesis (i.e., covariance matrices are equal) is statistical evidence that the groups can be treated as one.

The next series of testing consists of a model in which certain parameters are constrained to be equal across the subpopulations is compared with a less restrictive model

where these same parameters are free to take on any value [37][39]. In each of these tests, at least one of the scales or items making up each of the factors must be fixed to 1.0. In this study, the highest loading item (from previous factor analysis above) was fixed to 1.0. There is no guidance in the literature as to which item to fix, and to iteratively fix the various items in each factor is problematic. The choice uses that item which strongly loads into its respective factor, and therefore setting it to 1.0 seemed appropriate. The next test (hypothesis B) tests that there are four factors in all three subpopulations with a factor pattern of: Factor A consists of questions 1, 6, 11; Factor B consists of questions 2, 12; Factor C consists of questions 7, 8, 9, 10, 13; and Factor D consists of questions 3, 4, and 5. Assuming failure to reject hypothesis B, hypothesis C tests that there is invariance in factor loadings (lambda x) across the subpopulations. Assuming failure to reject hypothesis C, hypothesis D tests that there is invariance in the error/uniqueness (theta) across the subpopulations. Lastly, assuming failure to reject hypothesis D, hypothesis E tests that the factor variances and covariances (phi) are invariant across the three subpopulations.

For hypothesis B, subpopulations 2 and 3 are specified to have the same pattern and the same starting values as subpopulation 1 (LX=PS command on the LISREL 7 model input line). In hypothesis C, subpopulations 2 and 3 are specified

to be invariant for factor loading from subpopulation 1 (LX=IN command on the LISREL 7 model input line). Hypothesis D additionally constrains the theta matrices to be invariant (TD=IN command on the LISREL 7 model input line). Hypothesis E additionally constrains the phi matrices to be invariant (PH=IN command on the LISREL 7 model input line). Appendix E provides the PRELIS and LISREL commands used for each of the hypothesis testing.

The LISREL 7 computer program output provides the GFI and RMR for each subpopulation. The chi-square measure provided with the last subpopulation is the measure of the overall fit of the three subpopulations. Alternative indices used to help evaluate LISREL models in multiple sample analysis where the chi-square measure and degrees of freedom are reported as summed values from the multi-sample testing (as in this testing) are: the chi-square to the degrees of freedom ratio, and the chi-square likelihood ratio tests. The chi-square/degrees of freedom ratio is distributed as a t-statistic so that anything greater than 1.96 (in this instance, where n = 340, and alpha = 0.05) is significant [38]. The chi-square likelihood ratio (LR), also described as the chi-square difference test, is utilized where restricted nested models are used as in this case where hypotheses C, D, and E are restricted nested models of hypothesis B. The LR test is calculated by taking the difference in the chi-square estimators for the restricted and unrestricted models and the

difference in degrees of freedom (df) for the two models and reporting as a chi-square/df ratio [37][38][43].

5. Post Survey Interviews (Convergent Validity)

Convergent validity is the extent that a measure is correlated or "agrees" with other measures of the same construct [3]. Interviews were conducted with randomly selected members of the user groups at the Naval Hospitals Camp Lejeune, and Jacksonville. The interviews were conducted to assess users overall satisfaction with the system for comparison with the instrument's results. Additionally, the interviews were used to gain comments about the system, and the short-form UIS instrument used in this study. Subjects interviewed were assured that their responses would be kept confidential.

E. EVALUATION OF THE INSTRUMENT'S DATA

1. Testing Differences in Means

Oneway analysis-of-variance (ANOVA) testing was conducted as described above for testing homogeneity of sample data sets. First, the combined three hospital data set was used to test the difference in means between the three user groups (physicians, medical support, and administrative support) for each of the 13 questions, overall score, and factors. Using the combined data set, each user group was tested for differences in means between the three location sites (i.e., Charleston vs Camp Lejeune vs

Jacksonville). Lastly, each hospital's data was tested for differences in means between the three user groups.

Where significant differences in means occurred (i.e., P value less than 0.05), the Scheffe multiple comparison testing was conducted a posteriori. Additionally, a posteriori testing for normality and homogeneity of variance was conducted. Normality was tested using MINITAB's option for computing and storing fitted and residual values when performing oneway ANOVA procedure. Applying the NSCORE function to compute the normal scores of the residuals and then computing the correlation of the normal score with residuals approximates a normal distribution if the correlation is large (i.e., the closer to 1.0 the better) [30]. The Hartley's Fmax test was used for homogeneity of variance.

Nonparametric Kruskal-Wallis ANOVA testing of sample medians was conducted in those situations where parametric ANOVA testing assumptions were violated (i.e., lack of normality and/or homogeneity of variance). Using a PC version of MINITAB statistical program [30], the Kruskal-Wallis test statistic H and P values were calculated and adjusted for ties in responses. Where significant differences in medians occurred, the MINITAB [30] nonparametric Mann-Whitney two-sample median procedure was performed in pairwise comparisons to identify individual significant differences.

2. Time of Use Correlation Testing

The assumption held is that as the length of time of use of the system increased, the user's level of satisfaction would increase. The CHCS is a mandatory use system as opposed to an optional use system. As such, medical personnel must use the CHCS to accomplish their work (in those areas where respective CHCS modules have been installed).

Correlation measures the degree of association between two variables. The range of correlation strength can be from -1.0 (perfect negative correlation) to +1.0 (perfect positive correlation), with zero meaning no correlation. The term "negative" used here with correlation denotes that as one variable increases the other variable decreases. The term "positive" used with correlation denotes that as one variable increases the other variable increases. The independent variable used in this study was time of use of the CHCS (in terms of months). The dependent variable to test against were each factor's mean scores. The Pearson's sample correlation coefficient (r) was obtained for each comparison using MINITAB. It should be noted that rho and its estimate r are both symmetric so that the two variables to be correlated can be interchanged without changing the value. It is because of this symmetry that no cause and effect statement may be made, rather just the strength of association or relationship between the two variables [31].

The Pearson's sample correlation coefficient was tested for significance using a macro program provided by Zehna [31] for MINITAB. The testing of the sample correlation coefficient (r) used one-tail hypothesis testing where H1: rho > 0 if r was positive or H1: rho < 0 if r was negative to obtain the appropriate P value. A P value of less than 0.05 indicates that the null hypothesis of no correlation may be rejected. Correlations were performed on the combined three hospital data.

a. Trend Analysis

Hurd [1] found that none of the work groups demonstrated any high correlation between time of use and the level of satisfaction. However, he used six month time series intervals to look for possible trends (negative or positive) between the time of use of the CHCS and the overall UIS summed score. He found at the Naval Hospital Charleston, that physicians and administrative support tended to exhibit a positive trend-line, whereas, the ancillary group (which is part of the Medical Support group in this study) tended to exhibit a negative trend-line for overall satisfaction.

In this study, the trend analysis performed by Hurd [1] was replicated. Trend analysis of the mean score in six month intervals for each factor was conducted. The number of individuals involved in each six month interval and the percentage of the whole were tabulated to provide clarity

as to the weighing of the results. The trend analysis was performed on the combined three hospital data.

IV. DESCRIPTIVE FINDINGS

A. DEMOGRAPHIC FINDINGS BY LOCATION AND AS A GROUP

Of the two Naval hospitals surveyed in this study, 121 usable instruments were obtained from the Naval Hospital Camp Lejeune, and 118 usable instruments were obtained from the Naval Hospital Jacksonville. The response rates for the Naval Hospitals Camp Lejeune and Jacksonville were 48% and 47%, respectively. These rates of response were similar to that obtained by Hurd [1] in his study where he had 101 respondents and a response rate of 56%. Hurd's data from the Naval Hospital Charleston is used in this study. Appendix F contains a summary of the demographics by location and as a group (the three hospitals combined).

1. Age

Hurd's [1] data revealed an average age of respondents from the Naval Hospital Charleston to be 32 years, with a range in years from 19 to 56. The average age of respondents from the Naval Hospital Camp Lejeune was 33 years, with a range in years from 18 to 61. The average age of respondents from the Naval Hospital Jacksonville was 32 years, with a range in years from 19 to 56. The combined group had an average age of 32 years with a range in years from 18 to 61.

2. Gender

The gender of the respondents from the Naval Hospital Charleston were 57 (56%) male and 44 (44%) female. The gender of the respondents from the Naval Hospital Camp Lejeune were 73 (60%) male and 48 (40%) female. The gender of the respondents from the Naval Hospital Jacksonville were 83 (70%) male and 35 (30%) female. The gender split in the combined group of respondents were 213 (63%) male and 127 (37%) female.

3. Hospital Departments

Only outpatient departments were sampled. Work areas reported were in one of the following department types: clinic, administration, laboratory, pharmacy, or radiology. Figure 4.1 depicts the individual and combined hospital department types and percentages.

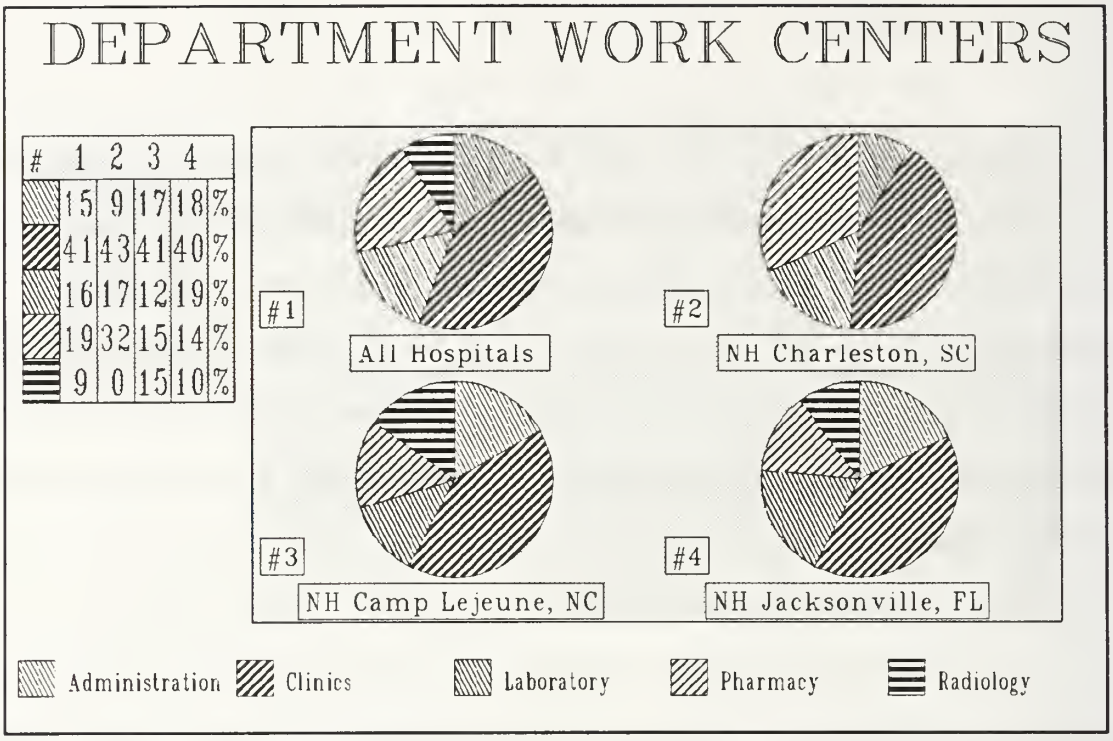

Figure 4.1. Department Work Centers

4. Job Descriptions

Job descriptions reported were categorized into one of the following types:

- Physician - a Medical Corps Officer or civilian equivalent.
- Nurse - a Nurse Corps Officer or civilian equivalent.
- Health Professional - a Medical Service Corps Officer (Allied Science) or civilian equivalent.
- Administrator - a Medical Service Corps Officer (Health Care Administration) or civilian equivalent.
- Technician - a Hospital Corpsman with a medical technician rating or civilian equivalent.
- Corpsman - a Hospital Corpsman without a technical rating.
- Clerical - a person performing secretarial or clerical functions.

Figure 4.2 depicts the individual and combined hospital job description types and percentages.

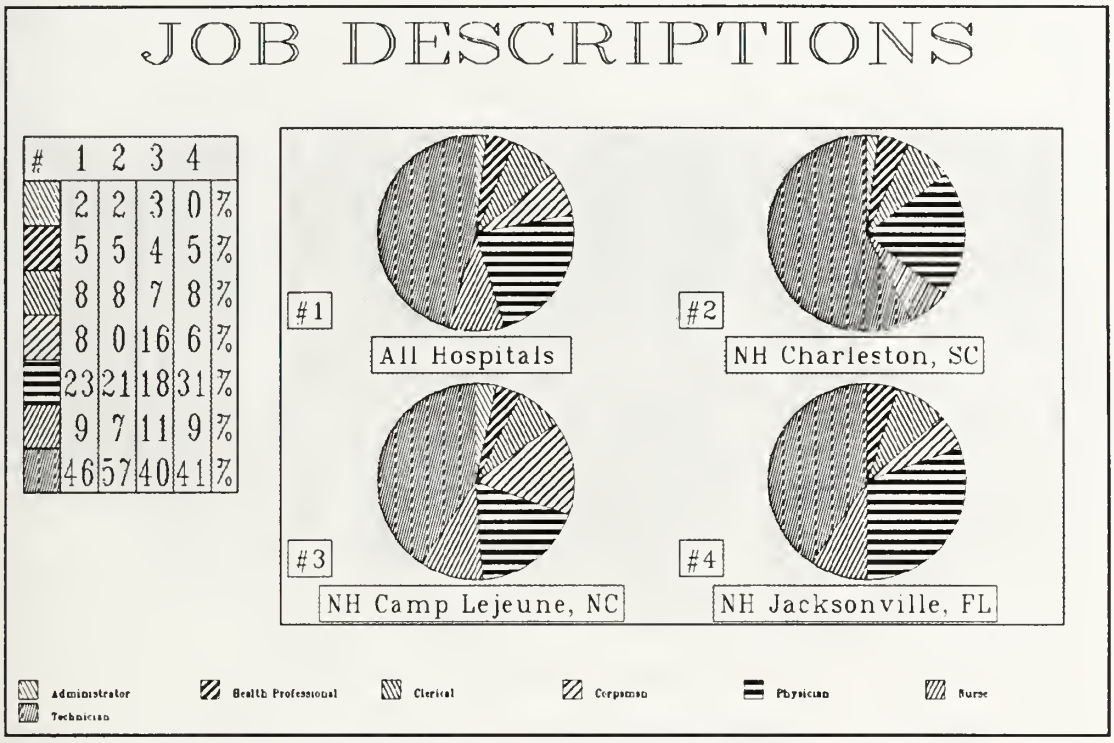

Figure 4.2. Job Description

5. Functional User Groups

Based on the person's work department and job description types they were categorized into three functional work groups: Physicians, Medical Support, and Administrative Support. The Physician group is self explanatory. The Medical Support group consisted of: nurses, health professionals, technicians, and corpsman not working in an administrative department. The Administrative Support group consisted of: all administrators, and clerical persons regardless of department assigned to, and all other persons regardless of profession assigned to an administrative

department. Figure 4.3 depicts the individual and combined hospital user group types and percentages.

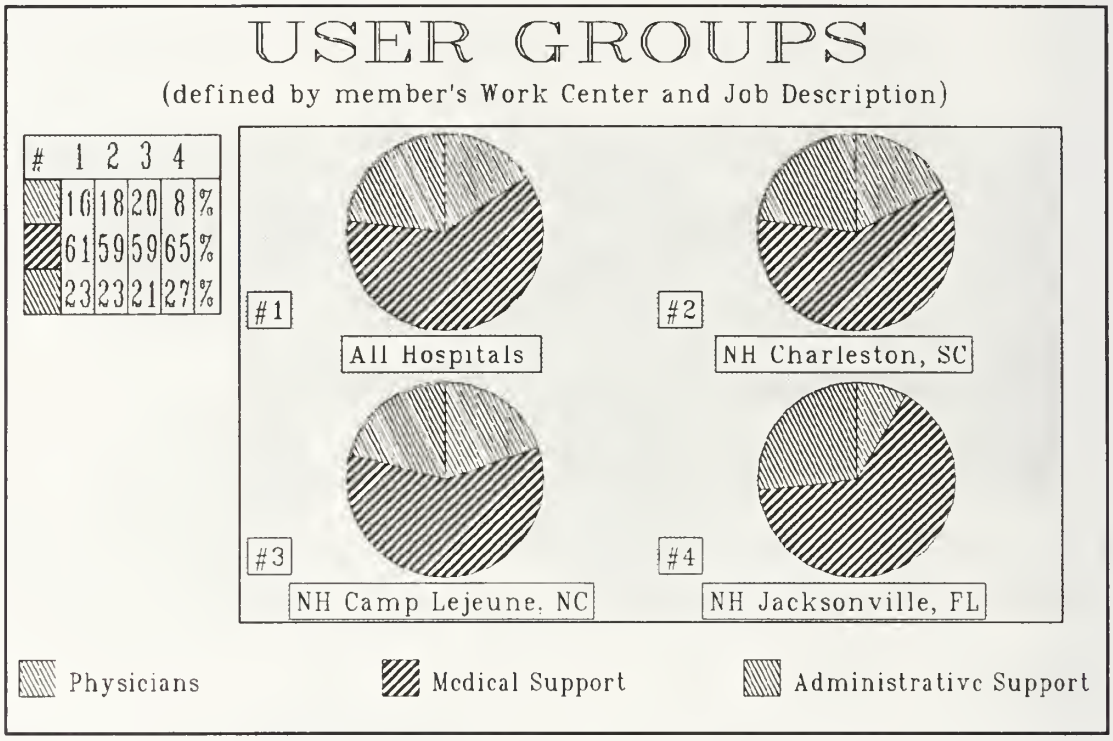

Figure 4.3. User Groups

6. Level of Education

As expected, the participants working within a health care setting possess a high level of education. Looking at the combined hospital data, Figure 4.4, almost 90% of the respondents have some college or higher educational experience. The median education level of the respondents from the Naval Hospital Charleston and from the Naval Hospital Camp Lejeune was "some college." The median education level of the respondents from the Naval Hospital Jacksonville was "bachelor degree." The median education

level of the combined group was "some college." Figure 4.4 depicts the individual and combined hospital level of education and percentages.

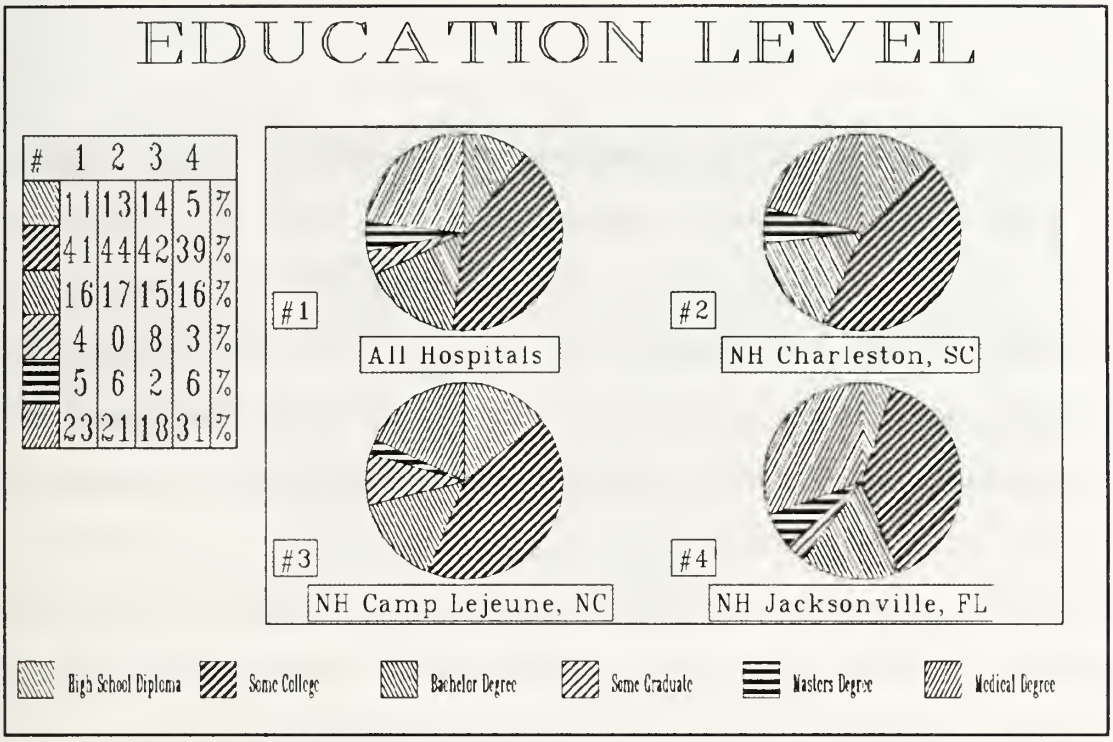

Figure 4.4. Education Level

7. Computer Use

Computer use is not an unfamiliar task with this group of participants. 80% of all the participants have used other computer systems of some sort. Of these users, nearly three quarters of them (74%) have used other health care information system(s). When comparing all respondents, 59% have used other health care information system (HCIS). The respondents from the Naval Hospital Charleston reported a 80% use of other computer systems; of those users, 71% have used a HCIS and of all respondents, 58% have used a HCIS. The

respondents from the Naval Hospital Camp Lejeune reported a 76% use of other computer systems; of those users, 68% have used a HCIS and of all respondents, 52% have used a HCIS. The respondents from the Naval Hospital Jacksonville reported a 86% use of other computer systems; of those users, 76% have used a HCIS and of all respondents, 66% have used a HCIS.

8. Length of Time of CHCS Use

Of all respondents, the average length of time in months of use of the CHCS was 12.3 months. The overall time of use ranged from one month to 36 months. The respondents from the Naval Hospital Charleston reported an average time of use of 8.6 months, with a range of one to 19 months. The respondents from the Naval Hospital Camp Lejeune reported an average time of use of 12.5 months, with a range of one to 36 months. The respondents from the Naval Hospital Jacksonville reported an average time of use of 15.3 months, with a range of one to 32 months.

B. VALIDATION OF THE INSTRUMENT

1. Homogeneity of the Sample Data Sets

The oneway ANOVA testing results are presented in Table 4.1a. Significant differences in means are denoted by underlining. Significant differences in subpopulation means were noted in the education and the time of use of CHCS user attributes.

TABLE 4.1A
USER ATTRIBUTES ANOVA TESTING

ATTRIBUTE	F VALUE	P VALUE	NSCORES CORRELATION	HARTLEY FMAX(1)
AGE	0.16	0.852	0.98	1.59
GENDER	2.48	0.086	0.88	1.18
COMPUTER SYSTEM EXPERIENCE	2.18	0.115	0.81	1.55
HOSPITAL INFORMATION SYSTEM EXPERIENCE	2.45	0.088	0.89	1.11
EDUCATION	**4.09**	**0.018**	0.93	1.17

Note:
(1) Hartley's $Fmax_{(3,112)}$ approximate critical value =1.803 alpha = 0.05

The Scheffe interval comparison testing for the education attribute is presented in Table 4.1b. Education was tested and found to have no significant correlation with the overall satisfaction, as well as with each of the four factors found when factor analysis was performed. Time of use of the CHCS system is discussed later in this paper.

TABLE 4.1B
SCHEFFE MULTIPLE COMPARISON TESTING OF EDUCATION ATTRIBUTE

	SITE LOCATION COMPARISONS		
USER ATTRIBUTE	CHARLESTON/ CAMP LEJEUNE	CHARLESTON/ JACKSONVILLE	CAMP LEJEUNE/ JACKSONVILLE
EDUCATION	NS(1)	NS(1)	S(2)

NOTES:
(1) NS = nonsignificant; no difference between the means
(2) S = significant difference between the means

2. Exploratory Factor Analysis

The combined data set (n=340) was used to perform the exploratory factor analysis procedure. The Cattell Scree Test suggested a maximum of five factors may possibly exist. The SAS maximum likelihood factor analysis procedure was written to sequentially perform a one-factor solution through a five-factor solution. The Kaiser's Measure of Sampling

Adequacy (MSA) had a value of 0.89 indicating a very good fit of the data for factor analysis. The maximum likelihood factor analysis procedure in SAS uses squared multiple correlations (SMC) as its initial starting estimate. The SMC is the lower bound for the reliability of each variable. The SAS squared canonical correlations (SCC) reported for each factor is the lower bound of reliability for that factor (from the variables that make up that factor) [33]. The one-factor solution made up of all 13 questions had a SCC value of 0.90.

The Schwarz's Bayesian Criterion (SBC) value kept decreasing for the two-factor and the three-factor solutions. This indicated that a greater than three-factor solution was optimal. The three-factor solution had a SBC of 219 and a Tucker and Lewis's Reliability Coefficient of 0.91. At the four-factor solution, the SBC reached its lowest value of 211, and rose to the value of 217 at the five-factor solution. Table 4.2 shows the optimal four-factor solution. The Tucker and Lewis's Reliability Coefficient was 0.95 for the four-factor solution.

Factor A is made up of questions 1, 6, and 11, and represents the local Management Information Department (MID) staff and services. Factor B is made up of questions 2, and 12, and represents the contractor's services. Factor C is made up of questions 7, 8, 9, 10, and 13, and represents the

information product output. Factor D is made up of questions 3, 4, and 5, and represents user knowledge and involvement.

3. Confirmatory Factor Analysis

Paramount to the maximum likelihood factor analysis procedure is that the data be multivariate normal. There is no easily defined test for multivariate normality that could be found in the literature. Instead, the Jöreskog and Sörbom's [39] LISREL model for analysis of non-normal variables was used. The Total Coefficient of Determination (TCD) for the variables was 0.997 indicating a very good fit to the four-factor solution. Other goodness of fit indices used supported the four-factor solution. The Goodness of Fit Index (GFI) was 0.985, and the Adjusted Goodness of Fit Index (AGFI) was 0.977.

The Root Mean Square Residual (RMR) was 0.041, which also supports the goodness of fit of the four-factor solution. Additionally, Standard Errors (SE) and t-values (LISREL's critical ratios) were performed for each of variable's loading into their respective factor. The SE's were all low (<.04), and the t-values were all large (>20) for each of variable factor loadings, which further supports the goodness of fit of the four-factor solution.

4. Reliability (Internal Consistency) Testing

Factor A is made up of questions 1, 6, and 11, and represents the local Management Information Department (MID) staff and services. Factor B is made up of questions 2, and

12, and represents the contractor's services. Factor C is made up of questions 7, 8, 9, 10, and 13, and represents the information product. Factor D is made up of questions 3, 4, and 5, and represents knowledge and involvement.

The Cronbach's alpha for Factor A was 0.89; for Factor B was 0.68; for Factor C was 0.87; and for Factor D was 0.75.

TABLE 4.2
MAXIMUM LIKELIHOOD FACTOR ANALYSIS WITH VARIMAX ROTATION

QUESTIONS/VARIABLES	FACTOR A MIO STAFF AND SERVICES	FACTOR B CONTRACTOR SERVICES	FACTOR C INFORMATION OUTPUT	FACTOR O KNOWLEDGE AND INVOLVEMENT	SMC
1 RELATIONSHIP WITH MIO STAFF	**0.75**	0.18	0 18	0.20	0.61
2. PROCESSING OF REQUESTS FOR CHANGES	0 12	**0.58**	0 19	0.16	0.36
3. OEGREE OF TRAINING PROVIOEO	0 27	0.34	0 16	**0.48**	0.43
4. USER'S UNDERSTANDING OF SYSTEM	0 16	0.11	0 10	**0.79**	0 37
5. USER'S FEELING OF PARTICIPATION	0.25	0 32	0.30	**0.51**	0.48
6. ATTITUDES OF MIO STAFF	**0.79**	0.14	0 20	0.15	0.63
7. RELIABILITY OF OUTPUT	0 16	0 25	**0.77**	0.07	0.61
8 RELEVANCY OF OUTPUT	0 23	0.32	**0.61**	0.15	0.54
9. ACCURACY OF OUTPUT	0 20	0 15	**0.75**	0 09	0.56
10 PRECISION OF OUTPUT	0.12	0.05	**0.71**	0 19	0.48
11 COMMUNICATING WITH MIO STAFF	**0.83**	0 14	0 22	0 19	0.69
12. TIME REQUIREO FOR NEW OEVELOPMENT	0.17	**0.69**	0.23	0.19	0 45
13. COMPLETENESS OF OUTPUT	0.20	0 44	**0.59**	0.10	0.57
Eigenvalue	4 10	2 30	15 90	1 30	--
Cumulative percent	17%	26%	94%	100%	--
SCC	0 80	0.70	0.94	0.56	--
Cronbach's Alpha	0 89	0.68	0 87	0 75	--

Schwarz Bayesian Criterion = 211
Tucker and Lewis Reliability Coefficient = 0.95

5. Testing for Measurement and Structural Invariance

The use of Jöreskog and Sörbom's LISREL model to test for measurement and structural invariance revealed that the three subpopulations are equivalent for their responses and the four-factor data reduction. Hypothesis A was that the covariance structure across the three subpopulations is

invariant. Hypothesis B was that the number of factors of the factor structure is the same across the three subpopulations is invariant. Hypothesis C was that the factor loading pattern across the three subpopulations is invariant. Hypothesis D was that the error/uniqueness structure is invariant across the three subpopulations. Hypothesis E was that the factor variances and covariances are invariant across the three subpopulations.

As mentioned previously in Chapter III, the chi-square/degrees of freedom ratio is distributed as a t-statistic so that anything greater than 1.96 is significant and therefore would reject the null hypothesis of invariance. Table 4.3 shows the testing results.

TABLE 4.3
EQUIVALENCE TESTING

	HYPOTHESIS	Chi^2	df	Chi^2/df	LR Test
A	COVARIANCE STRUCTURE IS THE SAME	242.4	182	1.33	--
B	NUMBER OF FACTORS IS THE SAME	331.2	177	1.87	--
C:	FACTOR LOADING IS THE SAME	341.0	195	1.75	0.55
D:	THE ERROR/UNIQUENESS IS THE SAME	383.6	221	1.74	1.19
E	FACTOR VARIANCES AND COVARIANCES ARE THE SAME	394.5	241	1.64	0.99

6. Post Survey Interviews (Convergent Validity)

During the one-day visits to the Naval Hospitals Camp Lejeune and Jacksonville, time constraints limited the number of individuals that were interviewed to a total of 15 (approximately 5% of the total sample population). In working around individual work schedules, an equal

distribution of interviews was obtained. Of the total 15 interviews, three were with physicians, three with administrative personnel, three with clinic personnel, three with laboratory personnel, and three with pharmacy personnel. During the interviews, the individuals were asked about their overall impression of satisfaction (satisfied or dissatisfied), and to comment about the system. All individuals interviewed had at least nine-months experience with the CHCS. Between interviews, there was an opportunity for first-hand use of the CHCS at the Naval Hospital Camp Lejeune's training room.

The majority of the physicians (2 out of 3) were overall dissatisfied with the CHCS. They sited a cumbersome menu interface, slow response time of system, and slow response time to change the system. The clinic, administrative, laboratory and pharmacy personnel interviewed expressed they were satisfied, but also echoed the same comments as the physicians.

Other general comments offered about the survey instrument were: 1) provide an example--the dual bipolar adjective pairs tended to confuse some and 2) the instrument did not address how the user interacted or put information into the system.

C. EVALUATION OF THE INSTRUMENT'S DATA

1. Testing Differences in Means

The combined three hospital data set was used to test the difference in means between the three user groups (Physicians, Medical Support, and Administrative Support) for each of the 13 questions, overall (summed) score, and factors (averaged score). Using the combined data set, each user group was tested for differences in means between the three location sites (i.e., Charleston vs Camp Lejeune vs Jacksonville). Lastly, each hospital's data was tested for differences in means between the three user groups. Figure 4.5 shows the level of satisfaction for each of the 13 questions and by each user group.

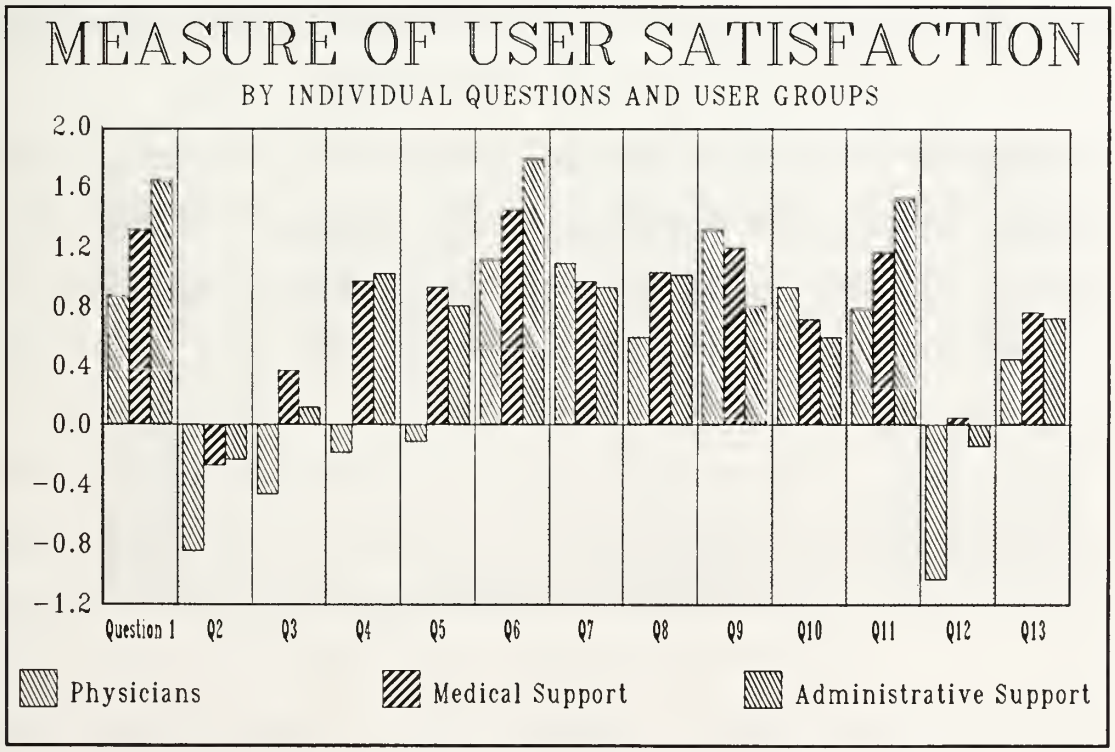

Figure 4.5. Measure of User Satisfaction

a. Combined Hospital Data

(1) Differences between User Groups

Table 4.4a shows the ANOVA testing results between user groups. Significant findings (at an alpha of 0.05) are underlined. The Physician group sample size consisted of 79 participants; the Medical Support group consisted of 207 participants; and the Administrative Support group consisted of 54 participants. The a posteriori testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. Except for questions 9 and 10, the Hartley Fmax test revealed homogeneity of variance between groups. Questions 9 and 10 were tested using the Kruskal-Wallis nonparametric ANOVA testing of sample medians. The nonparametric findings also showed no significant difference in medians. Questions 7, 8, 9, 10, and 13 which make up Factor C (information product output) revealed no significant differences. Factor C across the three user groups means were within the "slightly satisfied" range (0 to 1).

TABLE 4.4A
COMBINED HOSPITALS ANOVA TESTING; USER GROUPS

QUESTIONS/FACTORS	USER GROUP MEANS(1)			F VALUE	P VALUE	NSCORES CORRELATION	Hartley Fmax(2)
	P	M	A				
1. RELATIONSHIP WITH MID STAFF	0.88	1.32	1.65	**6.22**	**0.002**	0.98	1.12
2. PROCESSING OF REQUESTS FOR CHANGE	-0.85	-0.28	-0.24	**4.02**	**0.019**	0.98	1.54
3. DEGREE OF TRAINING	-0.47	0.39	0.12	**7.23**	**0.001**	0.99	1.34
4. USER'S UNDERSTANDING OF SYSTEM	-0.19	0.98	1.03	**16.33**	**0.000**	0.98	1.17
5. USER'S FEELING OF PARTICIPATION	-0.11	0.94	0.81	**14.24**	**0.000**	0.98	1.17
6. ATTITUDE OF MID STAFF	1.12	1.45	1.79	**4.37**	**0.013**	0.98	1.13
7. RELIABILITY OF OUTPUT	1.10	0.98	0.94	0.29	0.752	0.97	1.41
8. RELEVANCY OF OUTPUT	0.60	1.04	1.02	2.94	0.054	0.97	1.11
9. ACCURACY OF OUTPUT	1.32	1.20	0.81	2.43	0.089	0.97	**2.08**
10. PRECISION OF OUTPUT	0.94	0.72	0.60	1.26	0.285	0.98	**2.01**
11. COMMUNICATION WITH MID STAFF	0.79	1.17	1.53	**4.99**	**0.007**	0.98	1.35
12. TIME REQUIRED FOR NEW DEVELOPMENT	-1.04	0.05	-0.15	**13.05**	**0.000**	0.99	1.26
13. COMPLETENESS OF OUTPUT	0.45	0.77	0.73	1.28	0.279	0.98	1.16
OVERALL SCORE	4.54	10.71	10.62	**7.31**	**0.001**	0.99	1.69
A MID STAFF AND SERVICES	0.93	1.31	1.66	**6.49**	**0.002**	0.98	1.15
B. CONTRACTOR SERVICES	-0.95	-0.12	-0.19	**10.45**	**0.000**	0.99	1.35
C. INFORMATION OUTPUT	0.88	0.94	0.82	0.26	0.772	0.98	1.61
D. KNOWLEDGE AND INVOLVEMENT	-0.26	0.77	0.65	**18.70**	**0.000**	0.99	1.28

NOTES:
(1) P = Physicians; M = Medical Support; A = Administrative Support
(2) Hartley's $F_{max(3,112)}$ approximate critical value = 1.80 at alpha = 0.05

(2) Significant User Group Findings

Table 4.4b represents those items where the ANOVA testing in Table 4.4a revealed a significant difference in the means between the user groups. Scheffe multiple comparison testing was used to identify the individual differences between user groups. Physicians were less satisfied and displayed a significant difference between the other two user groups in virtually all the individual questions that make up Factor A (MID Staff and Services; questions 1, 6, and 11), Factor B (Contractor Services; questions 2 and 12), and Factor D (User Knowledge and Involvement; questions 3, 4, and 5).

TABLE 4.4B
SCHEFFE MULTIPLE COMPARISON TESTING; USER GROUPS

QUESTIONS/FACTORS	USER GROUPS COMPARISON		
	PHYSICIAN/ MEDICAL SUPPORT	PHYSICIAN/ ADMIN SUPPORT	MEDICAL SUPPORT/ ADMIN SUPPORT
1. RELATIONSHIP WITH MID STAFF	S(1)	S	NS(2)
2. PROCESSING OF REQUESTS FOR CHANGES	S	NS	NS
3. DEGREE OF TRAINING PROVIDED	S	NS	NS
4. USER'S UNDERSTANDING OF SYSTEM	S	S	NS
5. USER'S FEELING OF PARTICIPATION	S	S	NS
6. ATTITUDES OF MID STAFF	NS	S	NS
11. COMMUNICATING WITH MID STAFF	NS	S	NS
12. TIME REQUIRED FOR NEW DEVELOPMENT	S	S	NS
OVERALL SCORE	S	S	NS
A. MID STAFF AND SERVICES	S	S	NS
B. CONTRACTOR SERVICES	S	S	NS
C. KNOWLEDGE AND INVOLVEMENT	S	S	NS

NOTES:
(1) S = Significant difference in means
(2) NS = Nonsignicant: no difference in means

(3) Physician Group Differences by Site

Table 4.5a shows the ANOVA testing results for Physician user group between the three Naval hospital (NH) sites. Significant findings (at an alpha of 0.05) are underlined. The Physician group sample size at the NH Charleston consisted of 21 participants; NH Camp Lejeune consisted of 22 participants; and NH Jacksonville consisted of 36 participants. The a posteriori testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. Except for questions 7 and 13, the Hartley Fmax test revealed homogeneity of variance between groups. Questions 7 and 13 were tested using the Kruskal-Wallis nonparametric ANOVA testing of sample medians. The nonparametric findings also showed no significant difference in medians.

Questions 7, 8, 9, 10, and 13 which make up Factor C (information product output) revealed no significant differences. Factor C across the three sites for the Physician group were essentially within the "slightly satisfied" range (0 to 1). Other nonsignificant differences in means were found for questions 4 and 12. Questions 4 and 12 both were essentially within the "slightly dissatisfied" range (-1 to 0), and help make up Factors D and B respectively.

TABLE 4.5A
PHYSICIAN GROUP ANOVA TESTING

QUESTIONS/FACTORS	LOCATION SITE MEANS(1)			F VALUE	P VALUE	NSCORES CORRELATION	Hartley Fmax(2)
	CH	CL	JX				
1. RELATIONSHIP WITH MID STAFF	1.38	1.36	0.29	**9.23**	**0.000**	0 98	1.70
2. PROCESSING OF REQUESTS FOR CHANGE	-0 45	-0.05	-1.60	**8.81**	**0.000**	0.98	1.45
3. DEGREE OF TRAINING	0.05	0 05	-1 08	**5.99**	**0.004**	0.99	1.48
4. USER'S UNDERSTANDING OF SYSTEM	0.14	-0.59	-0.14	1.26	0.289	0.98	1.23
5. USER'S FEELING OF PARTICIPATION	0 55	-0.21	-0.44	**3.49**	**0.035**	0.97	1.69
6 ATTITUDE OF MIO STAFF	1.57	1.77	0 46	**12.06**	**0.000**	0.97	1.72
7. RELIABILITY OF OUTPUT	1.07	1.32	0.99	0.47	0.625	0.95	**3.13**
8 RELEVANCY OF OUTPUT	0.57	0.71	0.54	0.09	0.913	0.96	1.10
9. ACCURACY OF OUTPUT	1.41	1.50	1.17	0.80	0 451	0.97	1.98
10. PRECISION OF OUTPUT	0 86	0.86	1.04	0.32	0.728	0.98	1.76
11 COMMUNICATION WITH MID STAFF	1.36	1.34	0.13	**13.61**	**0.000**	0.99	1 40
12. TIME REQUIRED FOR NEW DEVELOPMENT	-0 93	-0 52	-1 42	2 61	0 075	0 98	1.15
13. COMPLETENESS OF OUTPUT	0.52	0 84	0.17	1.51	0.227	0 98	**5.07**
OVERALL SCORE	8 10	8.39	0.11	**7.21**	**0.001**	0 97	1 68
A MID STAFF AND SERVICES	1 44	1 49	0.29	**14.69**	**0.001**	0.98	1.24
B CONTRACTOR SERVICES	-0 69	-0.28	-1.50	**7.38**	**0.001**	0.99	1 74
C. INFORMATION OUTPUT	0 86	1.04	0.78	0 51	0 605	0.97	2.14
O. KNOWLEDGE AND INVOLVEMENT	0.25	-0.25	-0.56	**3.23**	**0.045**	0.99	2.05

NOTES:
(1) CH = NH Charleston; CL = NH Camp Lejeune; JX = NH Jacksonville
(2) Hartley's $Fmax_{(3,27)}$ approximate critical value = 2.57 at alpha = 0.05

(4) Significant Physician Group Findings

Table 4.5b represents those items where the ANOVA testing in Table 4.5a revealed a significant difference in the means between the Physician groups. Scheffe multiple comparison testing was used to identify the individual differences between sites.

Physicians at the NH Jacksonville were less satisfied and displayed a significant difference between the other two sites in all the individual questions (1, 6, and 11) that make up Factor A (MID Staff and Services). The NH Charleston and the NH Camp Lejeune Factor A findings were within the "quite satisfied" range (1 to 2) versus the NH

Jacksonville's findings within the "slightly satisfied" range (0 to 1). Physicians at the NH Jacksonville were less satisfied and displayed a significant difference between the other two sites for Factor B (Contractor Services; questions 2 and 12). Physicians at the NH Jacksonville were less satisfied as compared with the NH Charleston with Factor D (Knowledge and Involvement; questions 3, 4, 5), but demonstrated no difference between the NH Camp Lejeune. The NH Jacksonville, and the NH Camp Lejeune findings for Factor D were within the "slightly dissatisfied" range (-1 to 0) verses the NH Charleston's findings within the "slightly satisfied" range (0 to 1).

TABLE 4.5B
SCHEFFE MULTIPLE COMPARISON TESTING; PHYSICIAN GROUP

QUESTIONS/FACTORS	LOCATION SITE COMPARISONS		
	CHARLESTON/ CAMP LEJEUNE	CHARLESTON/ JACKSONVILLE	CAMP LEJEUNE/ JACKSONVILLE
1. RELATIONSHIP WITH MID STAFF	NS(1)	S(2)	S
2. PROCESSING OF REQUESTS FOR CHANGES	NS	S	S
3. DEGREE OF TRAINING PROVIDED	NS	S	S
5. USER'S FEELING OF PARTICIPATION	NS	S	NS
6. ATTITUDES OF MID STAFF	NS	S	S
11. COMMUNICATION WITH MID STAFF	NS	S	S
OVERALL SCORE	NS	S	S
A. MID STAFF AND SERVICES	NS	S	S
B. CONTRACTOR SERVICES	NS	S	S
D. KNOWLEDGE AND INVOLVEMENT	NS	S	NS

NOTES:
(1) NS = Nonsignificant; no difference in means
(2) S = Significant difference in means

(5) Medical Support Group Differences by Site

Table 4.6a shows the ANOVA testing results for Medical Support user group between the three naval hospital (NH) sites. Significant findings (at an alpha of 0.05) are underlined. The Medical Support group sample size at the NH Charleston consisted of 71 participants; at the NH Camp Lejeune consisted of 75 participants; and at the NH Jacksonville consisted of 61 participants. The a posteriori testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. The Hartley Fmax test revealed homogeneity of variance between groups.

Questions 7, 8, 9, 10, and 13 which make up Factor C (information product output) revealed no significant differences. Factor C across the three user groups means were essentially within the "slightly satisfied" range (0 to 1). Other nonsignificant differences in means was found for

question 4. Question 4 was essentially within the "slightly dissatisfied" range (0 to -1), and helps make up Factor D.

TABLE 4.6A
MEDICAL SUPPORT GROUP ANOVA TESTING

QUESTIONS/FACTORS	LOCATION SITE MEANS(1)			F VALUE	P VALUE	NSCORES CORRELATION	Hartley Fmax(2)
	CH	CL	JX				
1. RELATIONSHIP WITH MID STAFF	1.74	1.22	0.94	**6.88**	**0.001**	0.98	1.24
2. PROCESSING OF REQUESTS FOR CHANGE	-0.42	0.24	-0.76	**6.79**	**0.001**	0.99	1.69
3. DEGREE OF TRAINING	0.82	0.54	-0.30	**7.37**	**0.001**	0.98	1.05
4. USER'S UNDERSTANDING OF SYSTEM	1.33	0.82	0.77	2.58	0.078	0.97	1.42
5. USER'S FEELING OF PARTICIPATION	1.25	0.99	0.53	**3.66**	**0.027**	0.98	1.32
6. ATTITUDE OF MID STAFF	2.08	1.33	0.85	**16.91**	**0.000**	0.98	1.98
7. RELIABILITY OF OUTPUT	0.80	1.27	0.81	2.34	0.099	0.97	1.48
8. RELEVANCY OF OUTPUT	1.06	1.23	0.76	1.90	0.151	0.98	1.26
9. ACCURACY OF OUTPUT	1.31	1.33	0.91	1.68	0.189	0.97	1.20
10. PRECISION OF OUTPUT	0.58	0.79	0.79	0.53	0.591	0.97	1.22
11. COMMUNICATION WITH MID STAFF	1.73	1.03	0.68	**10.92**	**0.000**	0.98	1.64
12. TIME REQUIRED FOR NEW DEVELOPMENT	0.10	0.34	-0.36	**3.08**	**0.048**	0.99	1.32
13. COMPLETENESS OF OUTPUT	0.68	0.94	0.67	0.63	0.536	0.98	1.21
OVERALL SCORE	13.06	12.08	6.30	**5.02**	**0.007**	0.99	1.23
A. MID STAFF AND SERVICES	1.85	1.20	0.83	**14.10**	**0.000**	0.98	1.64
B. CONTRACTOR SERVICES	-0.16	0.29	-0.56	**6.09**	**0.003**	0.99	1.47
C. INFORMATION OUTPUT	0.89	1.11	0.79	1.27	0.284	0.98	1.26
D. KNOWLEDGE AND INVOLVEMENT	1.13	0.78	0.33	**6.36**	**0.002**	0.99	1.29

NOTES:
(1) CH = NH Charleston; CL = NH Camp Lejeune; JX = NH Jacksonville
(2) Hartley's $Fmax_{(3,68)}$ approximate critical value = 1.84 at alpha = 0.05

(6) Significant Medical Support Group Findings

Table 4.6b represents those items where the ANOVA testing in Table 4.6a revealed a significant difference in the means between the Medical Support groups. Scheffe multiple comparison testing was used to identify the individual differences between sites. For Factor A (MID Staff and Services) comprised of questions 1, 6, and 11, the NH Charleston was significantly different from the other two

sites. In each of the individual questions the NH Charleston was more satisfied ("quite satisfied" range of 1 to 2) than the two sites which were within the "slightly satisfied" range (0 to 1). For Factor B (Contractor Services), which was comprised of questions 2 and 12, the NH Jacksonville was less satisfied when compared with the NH Camp Lejeune, but had no significant difference between the NH Charleston. Both the NH Jacksonville and the NH Charleston findings for Factor B were within the "slightly dissatisfied" range (0 to -1), whereas the NH Camp Lejeune findings for Factor B were within the "slightly satisfied" range (0 to 1). Even though the NH Charleston and the NH Camp Lejeune have opposing findings for Factor B, they were still statistically nonsignificant for differences between their respective means. For Factor D (User Knowledge and Involvement), the NH Jacksonville scored less satisfied findings as compared with the NH Charleston, but no significant difference between the NH Camp Lejeune. However, all three sites for Factor D scored within essentially the "slightly satisfied" range (0 to 1).

TABLE 4.6B
SCHEFFE MULTIPLE COMPARISON TESTING; MEDICAL SUPPORT GROUP

QUESTIONS/FACTORS	LOCATION SITE COMPARISONS		
	CHARLESTON/ CAMP LEJEUNE	CHARLESTON/ JACKSONVILLE	CAMP LEJEUNE/ JACKSONVILLE
1. RELATIONSHIP WITH MID STAFF	S(1)	S	NS(2)
2. PROCESSING OF REQUESTS FOR CHANGES	NS	NS	S
3. DEGREE OF TRAINING PROVIDED	NS	S	S
5. USER'S FEELING OF PARTICIPATION	NS	S	NS
6. ATTITUDES OF MID STAFF	S	S	NS
11. COMMUNICATING WITH MID STAFF	S	S	NS
12. TIME REQUIRED FOR NEW DEVELOPMENT	NS	NS	NS
OVERALL SCORE	NS	S	S
A. MID STAFF AND SERVICES	S	S	NS
B. CONTRACTOR SERVICES	NS	NS	S
D. KNOWLEDGE AND INVOLVEMENT	NS	S	NS

NOTES:
(1) S = Significant difference in means
(2) NS = Nonsignificant; no difference in means

(7) Administrative Group Differences by Site

Table 4.7a shows the ANOVA testing results for Administrative Support user group between the three naval hospital (NH) sites. Significant findings (at an alpha of 0.05) are underlined. The Administrative Support group sample size at the NH Charleston consisted of 9 participants; NH Camp Lejeune consisted of 24 participants; and NH Jacksonville consisted of 21 participants. The a posteriori testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. Except for Factor B, the Hartley Fmax test revealed homogeneity of variance between groups.

Factor B which is the averaged score of questions 2 and 12, was tested using the Kruskal-Wallis nonparametric ANOVA testing of sample medians. The nonparametric findings showed significant difference in medians (P value = 0.01). However, the Mann-Whitney

nonparametric pairwise comparisons were the same as the Scheffe parametric findings as shown in Table 4.7b.

Factor D dealing with training, knowledge and involvement with the CHCS system was nonsignificant for differences in means between the three sites. Factor D is the average score of questions 3, 4, and 5. Factor D score was within the "slightly satisfied" range (0 to 1).

TABLE 4.7A
ADMINISTRATIVE SUPPORT GROUP ANOVA TESTING

QUESTIONS/FACTORS	LOCATION SITE MEANS(1)			F VALUE	P VALUE	NSCORES CORRELATION	Hartley Fmax(2)
	CH	CL	JX				
1 RELATIONSHIP WITH MID STAFF	1.89	2.19	0.93	**7.22**	**0.002**	0.97	1.67
2 PROCESSING OF REQUESTS FOR CHANGE	-1.28	0.25	-0.36	**5.04**	**0.010**	0.97	1.52
3. DEGREE OF TRAINING	-0.11	0.50	-0.21	1.20	0.308	0.99	1.74
4. USER'S UNDERSTANDING OF SYSTEM	0.00	1.33	1.22	2.24	0.117	0.98	1.41
5 USER'S FEELING OF PARTICIPATION	0.89	1.31	0.19	**3.35**	**0.043**	0.99	1.74
6. ATTITUDE OF MID STAFF	2.22	2.42	0.88	**13.87**	**0.000**	0.96	1.85
7. RELIABILITY OF OUTPUT	0.06	1.27	0.93	2.91	0.064	0.98	1.52
8. RELEVANCY OF OUTPUT	1.00	1.35	0.64	1.60	0.212	0.97	1.44
9 ACCURACY OF OUTPUT	-0.50	1.44	0.64	**7.85**	**0.001**	0.98	1.49
10. PRECISION OF OUTPUT	-0.44	1.08	0.50	**5.17**	**0.009**	0.98	2.21
11. COMMUNICATION WITH MID STAFF	1.72	2.17	0.71	**8.55**	**0.001**	0.97	1.14
12 TIME REQUIRED FOR NEW DEVELOPMENT	-1.06	0.13	-0.07	1.83	0.171	0.99	1.48
13 COMPLETENESS OF OUTPUT	0.06	1.04	0.67	1.56	0.220	0.98	1.29
OVERALL SCORE	4.44	16.48	6.57	**5.89**	**0.005**	0.99	1.68
A. MID STAFF AND SERVICES	1.95	2.26	0.84	**12.09**	**0.000**	0.97	1.24
B. CONTRACTOR SERVICES	-1.17	0.19	-0.21	**4.34**	**0.018**	0.99	1.74
C. INFORMATION OUTPUT	0.03	1.24	0.68	**4.66**	**0.014**	0.98	1.56
D. KNOWLEDGE AND INVOLVEMENT	0.26	1.05	0.37	2.04	0.141	0.99	1.19

NOTES:
(1) CH = NH Charleston; CL = NH Camp Lejeune; JX = NH Jacksonville
(2) Hartley's $Fmax_{(3,17)}$ approximate critical value = 3.30 at alpha = 0.05

(8) Significant Administrative Support Group Findings

Table 4.7b represents those items where the ANOVA testing in Table 4.7a revealed a significant difference

in the means between the Administrative Support groups. Scheffe multiple comparison testing was used to identify the individual differences between sites.

The Administrative Support group at the NH Jacksonville for Factor A (MID Staff and Services; questions 1, 6, and 11) were less satisfied than the other two sites. The NH Camp Lejeune and the NH Charleston were both essentially within the "quite satisfied" range (1 to 2), whereas the NH Jacksonville was within the "slightly satisfied" range (0 to 1).

The NH Charleston for Factor B (Contractor Services; questions 2 and 12) was less satisfied than the other two sites. The NH Camp Lejeune for Factor B was within the "slightly satisfied" range (0 to 1), and the NH Jacksonville was within the "slightly dissatisfied" range (0 to -1), but was not statistically different. The NH Charleston for Factor B was within the "quite dissatisfied" range (-1 to -2).

For Factor C (Information Product Output; questions 7, 8, 9, 10, and 13), the NH Charleston was less satisfied as compared with the NH Camp Lejeune, however, scored no difference with the NH Jacksonville. The significant influence to this finding was the significant differences paralleled with questions 9 and 10 dealing with output accuracy and precision. Both the NH Camp Lejeune and the NH Jacksonville were essentially within the "slightly

satisfied" range (0 to 1) for Factor C, whereas, the NH Charleston was "neutral" with a zero score.

TABLE 4.7B
SCHEFFE MULTIPLE COMPARISON TESTING; ADMIN SUPPORT GROUP

QUESTIONS/FACTORS	LOCATION SITE COMPARISONS		
	CHARLESTON/ CAMP LEJEUNE	CHARLESTON/ JACKSONVILLE	CAMP LEJEUNE/ JACKSONVILLE
1 RELATIONSHIP WITH MID STAFF	NS(1)	NS	S(2)
2. PROCESSING OF REQUESTS FOR CHANGES	S	NS	NS
5. USER'S FEELING OF PARTICIPATION	NS	NS	S
6. ATTITUDES OF MID STAFF	NS	S	S
9. ACCURACY OF OUTPUT	S	NS	NS
10. PRECISION OF OUTPUT	S	NS	S
11 COMMUNICATION WITH MID STAFF	NS	NS	S
OVERALL SCORE	S	NS	S
A MID STAFF AND SERVICES	NS	S	S
B. CONTRACTOR SERVICES	S	S	NS
C. INFORMATION OUTPUT	S	NS	NS

NOTES:
(1) NS = Nonsignificant; no difference in means
(2) S = Significant difference in means

b. The Naval Hospital Charleston

(1) Differences between User Groups

Table 4.8a shows the ANOVA testing results between user groups. Significant findings (at an alpha of 0.05) are underlined. The Physician group sample size consisted of 21 participants; the Medical Support group consisted of 71 participants; and the Administrative Support group consisted of 9 participants. The a posteriori testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. The disparity in the size of the user groups sample sizes lead to reject homogeneity of variance in a number of questions. However,

on subsequent testing using nonparametric procedures revealed essentially the same results and patterns.

TABLE 4.8A
NH CHARLESTON USER GROUP ANOVA TESTING

QUESTIONS/FACTORS	USER GROUP MEANS(1)			F VALUE	P VALUE	NSCORES CORRELATION	Hartley Fmax(2)
	P	M	A				
1. RELATIONSHIP WITH MIO STAFF	1 38	1.74	1 89	0 84	0 433	0 98	1 38
2. PROCESSING OF REQUESTS FOR CHANGE	-0 45	-0 42	-1.28	1.08	0.345	0 99	**2.48**
3. DEGREE OF TRAINING	0.05	0.82	-0.11	2 49	0.088	0 98	1.98
4. USER'S UNDERSTANDING OF SYSTEM	0.14	1.33	0.00	**6.99**	**0.001**	0 98	1 39
5. USER'S FEELING OF PARTICIPATION	0.55	1.25	0.89	1.70	0 188	0 97	1.46
6. ATTITUDE OF MID STAFF	1.57	2 08	2 22	2 41	0.095	0 98	1 31
7. RELIABILITY OF OUTPUT	1.07	0 80	0.06	1.53	0.221	0 98	**3.99**
8 RELEVANCY OF OUTPUT	0.57	1.06	1.00	1.02	0.366	0 98	1.39
9. ACCURACY OF OUTPUT	1 41	1.31	-0.50	**6.82**	**0.002**	0 98	**2.59**
10. PRECISION OF OUTPUT	0.86	0.58	-0 44	2.77	0.068	0 98	**3.81**
11 COMMUNICATION WITH MID STAFF	1 36	1 73	1 72	0.89	0 413	0 98	1 18
12. TIME REQUIREO FOR NEW OEVELOPMENT	-0 93	0.10	-1.06	**4.79**	**0.010**	0 99	1.37
13. COMPLETENESS OF OUTPUT	0 52	0 68	0.06	0.78	0 459	0 99	**3.98**
OVERALL SCORE	8 10	13 06	4 44	**3.22**	**0.044**	0.99	2 19
A. MIO STAFF AND SERVICES	1 44	1 85	1 95	1 58	0 211	0 98	1 17
B. CONTRACTOR SERVICES	-0 69	-0.16	-1 17	**3.19**	**0.045**	0 99	**3.76**
C INFORMATION OUTPUT	0 89	0 89	0.03	2 23	0.113	0 98	1 85
O. KNOWLEDGE AND INVOLVEMENT	0.25	1 13	0.26	**5.79**	**0.004**	0 99	1 22

NOTES
(1) P = Physicians; M = Medical Support, A = Administrative Support
(2) Hartley's $Fmax_{(3\ 33)}$ approximate critical value = 2 35 at alpha = 0.05

(2) Significant User Group Findings

Table 4.8b represents those items where the ANOVA testing in Table 4.8a revealed a significant difference in the means between the user groups. Scheffe multiple comparison testing was used to identify the individual differences between user groups. Physicians were less satisfied when compared with the Medical Support group for Factor D (User Knowledge and Involvement); no difference with the Administrative Support group. Physicians and the

Administrative Support group were within the "slightly satisfied" range (0 to 1). Whereas, the Medical Support group was within the "quite satisfied" range (1 to 2). Factor B dealing with Contractor services (questions 2 and 12), on multiple comparison testing found that there was no significant difference between the groups. All groups for Factor B were essentially within the "slightly dissatisfied" range (0 to -1). Again, the small sample size of the Administrative Support group plays a role in the resulting nonsignificant findings.

Interesting, the Administrative Support group were less satisfied than the other two groups as to the accuracy of the output (question 9). However, there were nonsignificant differences between all groups found in Factor C which is made up of questions 7, 8, 9, 10, and 13.

TABLE 4.8B
SCHEFFE MULTIPLE COMPARISON TESTING; NH CHARLESTON USER GROUPS

QUESTIONS/FACTORS	USER GROUPS COMPARISON		
	PHYSICIAN/ MEDICAL SUPPORT	PHYSICIAN/ ADMIN SUPPORT	MEDICAL SUPPORT/ ADMIN SUPPORT
4. USER'S UNDERSTANDING OF SYSTEM	S(1)	NS(2)	NS
9. ACCURACY OF OUTPUT	NS	S	S
12. TIME REQUIRED FOR NEW DEVELOPMENT	S	NS	NS
OVERALL SCORE	NS	NS	NS
B. CONTRACTOR SERVICES	NS	NS	NS
D. KNOWLEDGE AND INVOLVEMENT	S	NS	NS

NOTES:
(1) S = Significant difference in means
(2) NS = Nonsignificant; no difference in means

c. Naval Hospital Camp Lejeune

(1) Differences between User Groups

Table 4.9a shows the ANOVA testing results between user groups. Significant findings (at an alpha of 0.05) are underlined. The Physician group sample size consisted of 22 participants; the Medical Support group consisted of 75 participants; and the Administrative Support group consisted of 24 participants. The a posteriori testing for normality via the NSCORES correlation demonstrates that the data has a normal distribution. Except for questions 6 and 9, the Hartley Fmax test revealed homogeneity of variance between groups. However, on subsequent testing using nonparametric procedures, resulted in finding essentially the same values and patterns.

Although, the Physician group's mean value for Factor B (Contractor Services; questions 2 and 12) was within the "slightly dissatisfied" range (0 to -1), and the other two groups were within the "slightly satisfied" range of (0 to 1), there was no significant difference in means between the groups. There was no significant difference between the three groups concerning the information product output (Factor C; questions 7, 8, 9, 10, and 13). All three groups were within the "quite satisfied" range (1 to 2) for Factor C.

TABLE 4.9A
NH CAMP LEJEUNE USER GROUP ANOVA TESTING

QUESTIONS/FACTORS	USER GROUP MEANS(1)			F VALUE	P VALUE	NSCORES CORRELATION	Hartley Fmax(2)
	P	M	A				
1. RELATIONSHIP WITH MIO STAFF	1.36	1.22	2.19	**5.78**	**0.004**	0.98	1.76
2. PROCESSING OF REQUESTS FOR CHANGE	-0.05	0.24	0.25	0.37	0.690	0.98	1.25
3. DEGREE OF TRAINING	0.05	0.52	0.50	0.75	0.475	0.99	1.07
4. USER'S UNDERSTANDING OF SYSTEM	-0.59	0.82	1.33	**7.95**	**0.001**	0.98	1.17
5. USER'S FEELING OF PARTICIPATION	-0.21	0.99	1.31	**7.98**	**0.001**	0.99	1.47
6 ATTITUDE OF MID STAFF	1.77	1.33	2.42	**7.09**	**0.001**	0.98	**2.32**
7. RELIABILITY OF OUTPUT	1.32	1.27	1.27	0.01	0.989	0.96	1.31
8. RELEVANCY OF OUTPUT	0.71	1.23	1.35	1.64	0.199	0.98	1.30
9. ACCURACY OF OUTPUT	1.50	1.33	1.44	0.19	0.828	0.98	**2.85**
10. PRECISION OF OUTPUT	0.86	0.79	1.08	0.45	0.637	0.97	1.54
11. COMMUNICATION WITH MIO STAFF	1.34	1.03	2.17	**6.59**	**0.002**	0.98	2.07
12 TIME REQUIRED FOR NEW DEVELOPMENT	-0.52	0.34	0.13	2.63	0.076	0.99	1.50
13 COMPLETENESS OF OUTPUT	0.84	0.93	1.04	0.11	0.897	0.98	1.41
OVERALL SCORE	8.39	12.08	16.48	2.53	0.084	0.99	1.54
A MIO STAFF AND SERVICES	1.49	1.20	2.26	**8.45**	**0.000**	0.98	1.43
B. CONTRACTOR SERVICES	-0.28	0.29	0.19	1.64	0.199	0.99	1.13
C. INFORMATION OUTPUT	1.05	1.11	1.24	0.20	0.823	0.99	1.39
D. KNOWLEDGE AND INVOLVEMENT	-0.25	0.78	1.05	**6.61**	**0.002**	0.99	1.21

NOTES
(1) P = Physicians; M = Medical Support; A = Administrative Support
(2) Hartley's $Fmax_{(3,39)}$ approximate critical value = 2.24 at alpha = 0.05

(2) Significant User Group Findings

Table 4.9b represents those items where the ANOVA testing in Table 4.9a revealed a significant difference in the means between the user groups. Scheffe multiple comparison testing was used to identify the individual differences between user groups.

The Medical Support group was less satisfied when compared with the Administrative Support group for Factor A (MID Staff and Services; questions 1, 6, 11), and no significant difference with the Physician group. The Medical Support group and the Physician group for Factor A were within the "quite satisfied" range (1 to 2), whereas the

Administrative Support group was within the "extremely satisfied" range (2 to 3). The Physician group was less satisfied for Factor D (User Knowledge and Involvement; questions 3, 4, 5) than the two other groups. The Physician group for Factor D were within the "slightly dissatisfied" range (0 to -1), whereas, the other two groups were essentially within the "slightly satisfied" range (0 to 1).

TABLE 4.9B
SCHEFFE MULTIPLE COMPARISON TESTING; NH CAMP LEJEUNE USER GROUPS

QUESTIONS/FACTORS	USER GROUPS COMPARISON		
	PHYSICIAN/ MEDICAL SUPPORT	PHYSICIAN/ ADMIN SUPPORT	MEDICAL SUPPORT/ ADMIN SUPPORT
1. RELATIONSHIP WITH MID STAFF	NS(1)	NS	S(2)
4. USER'S UNDERSTANDING OF SYSTEM	S	S	NS
5. USER'S FEELING OF PARTICIPATION	S	S	NS
6. ATTITUDES OF MID STAFF	NS	NS	S
11. COMMUNICATION WITH MID STAFF	NS	NS	S
A. MIS STAFF AND SERVICES	S	NS	S
D. KNOWLEDGE AND INVOLVEMENT	S	S	NS

NOTES
(1) NS = Nonsignificant, no difference in means
(2) S = Significant difference in means

d. Naval Hospital Jacksonville

(1) Differences between User Groups

Table 4.10a shows the ANOVA testing results between user groups. Significant findings (at an alpha of 0.05) are underlined. The Physician group sample size consisted of 36 participants; the Medical Support group consisted of 61 participants; and the Administrative Support group consisted of 21 participants. The a posteriori testing for normality via the NSCORES correlation demonstrates that

the data has a normal distribution. The Hartley Fmax test revealed homogeneity of variance between user groups.

There was no significant difference between user group means for Factor C (Information Product Output; questions 7, 8, 9, 10, and 13). All user groups were within the "slightly satisfied" range (0 to 1) for Factor C. Question 3 dealing with the degree of training was found initially to have significant differences in user group means. However, on subsequent testing as denoted in Table 4.10b, there was no significant difference. All user groups for question 3 were essentially within the "slightly dissatisfied" range (0 to -1).

TABLE 4.10A
NH JACKSONVILLE USER GROUP ANOVA TESTING

QUESTIONS/FACTORS	USER GROUP MEANS(1)			F VALUE	P VALUE	NSCORES CORRELATION	Hartley Fmax(2)
	P	M	A				
1. RELATIONSHIP WITH MIO STAFF	0.29	0.94	0.93	**3.70**	**0.028**	0.99	1.44
2. PROCESSING OF REQUESTS FOR CHANGE	-1.58	-0.76	-0.36	**5.18**	**0.007**	0.99	2.19
3. DEGREE OF TRAINING	-1.08	-0.30	-0.21	**3.29**	**0.041**	0.99	1.58
4. USER'S UNDERSTANDING OF SYSTEM	-0.14	0.77	1.12	**5.80**	**0.004**	0.98	1.18
5. USER'S FEELING OF PARTICIPATION	-0.44	0.53	0.19	**4.81**	**0.010**	0.99	2.00
6. ATTITUDE OF MIO STAFF	0.46	0.85	0.88	1.34	0.265	0.98	1.89
7. RELIABILITY OF OUTPUT	0.99	0.81	0.93	0.17	0.846	0.97	1.12
8. RELEVANCY OF OUTPUT	0.54	0.76	0.64	0.26	0.772	0.98	1.07
9. ACCURACY OF OUTPUT	1.17	0.91	0.64	1.02	0.364	0.97	1.51
10. PRECISION OF OUTPUT	1.04	0.79	0.50	1.34	0.266	0.99	1.81
11. COMMUNICATION WITH MID STAFF	0.13	0.68	0.71	2.61	0.078	0.99	2.01
12. TIME REQUIRED FOR NEW DEVELOPMENT	-1.42	-0.36	-0.07	**6.08**	**0.003**	0.99	1.40
13. COMPLETENESS OF OUTPUT	0.17	0.67	0.67	1.15	0.319	0.97	1.64
OVERALL SCORE	0.11	6.30	6.57	**3.19**	**0.045**	0.99	2.22
A. MIO STAFF AND SERVICES	0.29	0.83	0.84	2.96	0.056	0.98	1.74
B. CONTRACTOR SERVICES	-1.50	-0.56	-0.21	**7.27**	**0.001**	0.99	2.09
C. INFORMATION OUTPUT	0.78	0.79	0.68	0.07	0.931	0.98	1.39
D. KNOWLEDGE AND INVOLVEMENT	-0.56	0.33	0.37	**6.50**	**0.002**	0.99	2.09

NOTES:
(1) P = Physicians; M = Medical Support; A = Administrative Support
(2) Hartley's $F_{max(3,38)}$ approximate critical value = 2.25 at alpha = 0.05

(2) Significant User Group Findings

Table 4.10b represents those items where the ANOVA testing in Table 4.10a revealed a significant difference in the means between the user groups. Scheffe multiple comparison testing was used to identify the individual differences between user groups.

The Physician group was significantly less satisfied for Factor B (Contractor Services; questions 2 and 12) than the other two user groups. The Medical Support group and the Administrative Support group for Factor B were within the "slightly dissatisfied" range (0 to -1) whereas, the Physician group was within the "quite dissatisfied" range

(-1 to -2). The Physician group was significantly less satisfied for Factor D (User Knowledge and Involvement; questions 3, 4, and 5) than the two other user groups. The Medical Support group and the Administrative Support group for Factor D were within the "slightly satisfied" range (0 to 1) whereas, the Physician group was within the "slightly dissatisfied" range (0 to -1).

TABLE 4.10B
SCHEFFE MULTIPLE COMPARISON TESTING; NH JACKSONVILLE USER GROUPS

QUESTIONS/FACTORS	USER GROUPS COMPARISON		
	PHYSICIAN/ MEDICAL SUPPORT	PHYSICIAN/ ADMIN SUPPORT	MEDICAL SUPPORT/ ADMIN SUPPORT
1. RELATIONSHIP WITH MID STAFF	S(1)	NS(2)	NS
2. PROCESSING OF REQUESTS FOR CHANGES	S	S	NS
3. DEGREE OF TRAINING PROVIDED	NS	NS	NS
4. USER'S UNDERSTANDING OF SYSTEM	S	S	NS
5. USER'S FEELING OF PARTICIPATION	S	NS	NS
12. TIME REQUIRED FOR NEW DEVELOPMENT	S	S	NS
OVERALL SCORE	S	S	NS
B. CONTRACTOR SERVICES	S	S	NS
D. KNOWLEDGE AND INVOLVEMENT	S	S	NS

NOTES:
(1) S = Significant difference in means
(2) NS = Nonsignificant; no difference in means

2. Time of Use Correlation

Table 4.11 shows the breakdown of the three hospital data for correlation as well as trend analysis mid-points of user's level of satisfaction with time of use of the CHCS. User time of use of the CHCS was compared against each of the four factors (MID Staff and Services, Contractor Services, Information Product Output, and User Knowledge and Involvement). Significant findings are underlined.

TABLE 4.11
TIME OF USE CORRELATION AND TRENDS
(COMBINED THREE HOSPITAL DATA)

FACTOR/GROUP	CORRELATION		TRENDS BY 6 MONTH INTERVALS MEAN SCORES			
	PEARSON'S CORRELATION COEFFICIENT (r)	RHO TEST P VALUE	0-5	6-11	12-17	18+
FACTOR A:						
ALL GROUPS	-0.016	0.38	1.29	1.31	1.39	1.14
SAMPLE SIZE	340	--	67	98	81	94
PERCENT OF	--	--	20%	29%	23%	28%
PHYSICIANS	-0.080	0.24	0.94	1.13	0.81	0.76
SAMPLE SIZE	79	--	18	25	19	17
PERCENT OF	--	--	23%	32%	24%	21%
MEDICAL SUPPORT	-0.084	0.11	1.45	1.27	1.55	1.03
SAMPLE SIZE	207	--	39	60	52	56
PERCENT OF	--	--	19%	29%	25%	27%
ADMIN SUPPORT	+0.133	0.16	1.30	1.82	1.62	1.74
SAMPLE SIZE	54	--	10	13	10	21
PERCENT OF	--	--	19%	24%	19%	38%
FACTOR B:						
ALL GROUPS	-0.041	+0.22	-0.18	-0.23	-0.38	-0.47
PHYSICIANS	-0.084	+0.23	-0.83	-0.88	-0.80	-1.32
MEDICAL SUPPORT	-0.105	+0.06	+0.24	-0.02	-0.29	-0.29
ADMIN SUPPORT	+0.122	+0.18	-0.63	+0.04	0.00	-0.23
FACTOR C:						
ALL GROUPS	+0.027	+0.30	+0.77	+1.03	+0.92	+0.87
PHYSICIANS	+0.057	+0.30	+0.58	+1.02	+1.13	+0.74
MEDICAL SUPPORT	-0.045	+0.25	+0.24	-0.02	-0.29	-0.29
ADMIN SUPPORT	+0.268	+0.03	-0.08	+1.19	+0.74	+1.05
FACTOR D:						
ALL GROUPS	+0.030	+0.29	+0.41	+0.64	+0.53	+0.44
PHYSICIANS	-0.125	+0.13	+0.01	-0.23	-0.39	-0.43
MEDICAL SUPPORT	+0.014	+0.42	+0.67	+0.89	+0.90	+0.60
ADMIN SUPPORT	+0.120	+0.19	+0.12	+1.17	+0.32	+0.75

The Administrative Support group demonstrated a significant positive correlation (Pearson's sample correlation coefficient r=.27, P value=0.03) for time of use of the CHCS and Factor C (Information Product Output). These findings suggest that as the time of use increases, the Administrative Support group's level of satisfaction with the information product output increases. There were no other significant correlations noted.

Table 4.11 shows the breakdown of the three hospital data for trend analysis of user's level of satisfaction at six month interval time periods of use of the CHCS. A word of caution about trend analysis. The trend analysis points

are derived from the mean of the respective scores in each six month time series interval. One form of time series trend analysis attempts to fit a straight line (linear relationship trend line) between these points, and is generally used in forecasting. As such, these findings are only suggestive and based on observable straight line fitting of the data. The six month intervals used to look at trends are fairly evenly distributed for each of the groups so as to limit a weighting problem.

a. Factor A (MID Staff and Services) Trends

Figure 4.6 shows the plotting of the six month mean scores by All Groups combined as well as each of the individual user groups for Factor A (MID Staff and Services) trends. Although all scores demonstrate at least within the "slightly satisfied" range (0 to 1), the Physician and Medical Support user groups appear to have a downward trend. This suggests that as Physician and Medical Support personnel increase the time of use of the system, their level of satisfaction with the local MID staff and services diminishes; whereas, the Administrative Support user group appears to have an upward trend. This suggests that as Administrative Support personnel increase the time of use of the system, their level of satisfaction with the local MID staff and services increases.

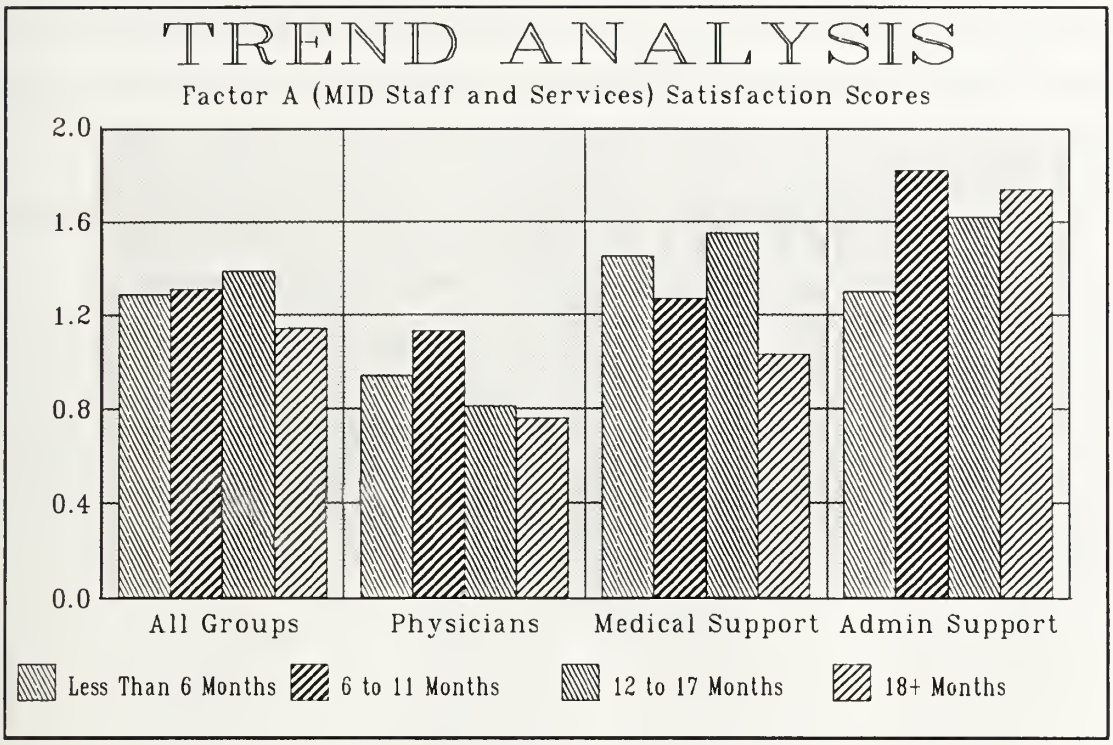

Figure 4.6. Trend Analysis Factor A

b. Factor B (Contractor Services) Trends

Figure 4.7 shows the plotting of the six-month mean scores by All Groups combined as well as each of the individual user groups for Factor B (Contractor Services) trends. The Physician and Medical Support user groups appear to have a downward trend. This suggests that as Physician and Medical Support personnel increase the time of use of the system, their level of satisfaction with the contractor services (i.e., changes to the system) diminishes. The Physician and Medical Support user groups make up a large

percentage of users in this study, and this contributes to the very noticeable downward trend for the All Group category.

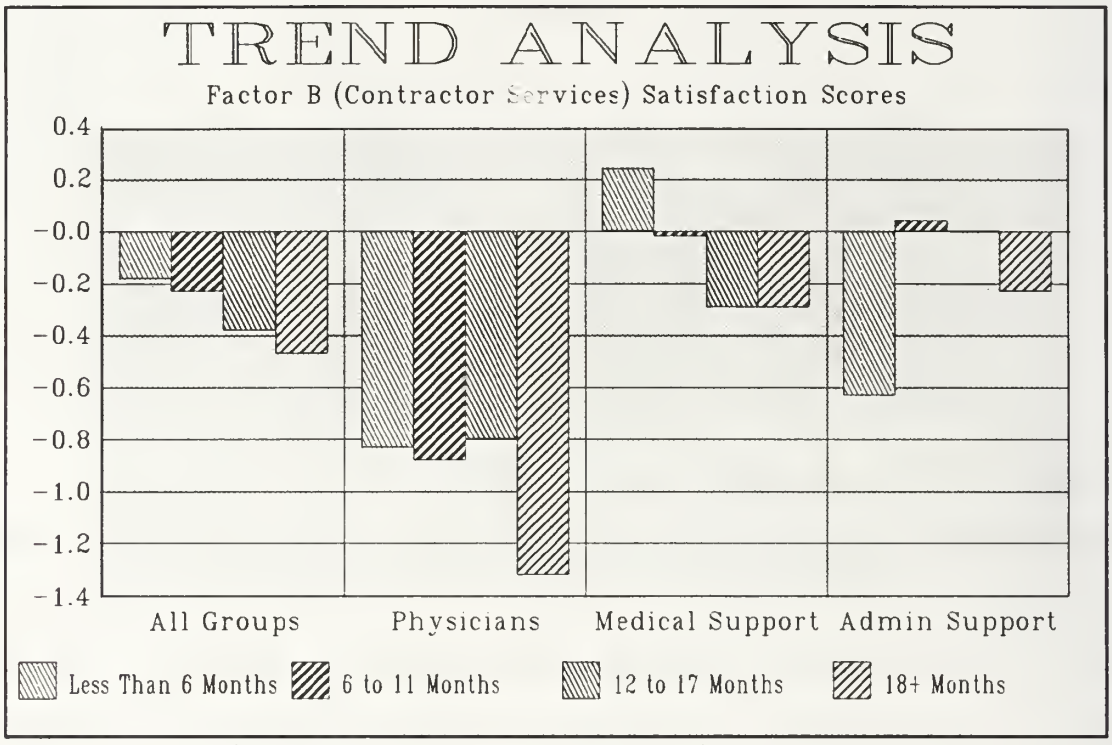

Figure 4.7. Trend Analysis Factor B

c. Factor C (Information Product Output) Trends

Figure 4.8 shows the plotting of the six-month mean scores by All Groups combined as well as each of the individual user groups for Factor C (Information Product Output) trends. The Medical Support user group appears to have a downward trend. This suggests that as Medical Support personnel increase the time of use of the system, their level of satisfaction with the information product output diminishes. As expected, the Administrative Support user group appears to have a sharp upward trend (this factor also

had a positive correlation). This suggests that as Administrative Support personnel increase the time of use of the system, their level of satisfaction with the information product output increases. The Physician user group appears to have an upward trend up through the first 17 months of use, and then thereafter drops.

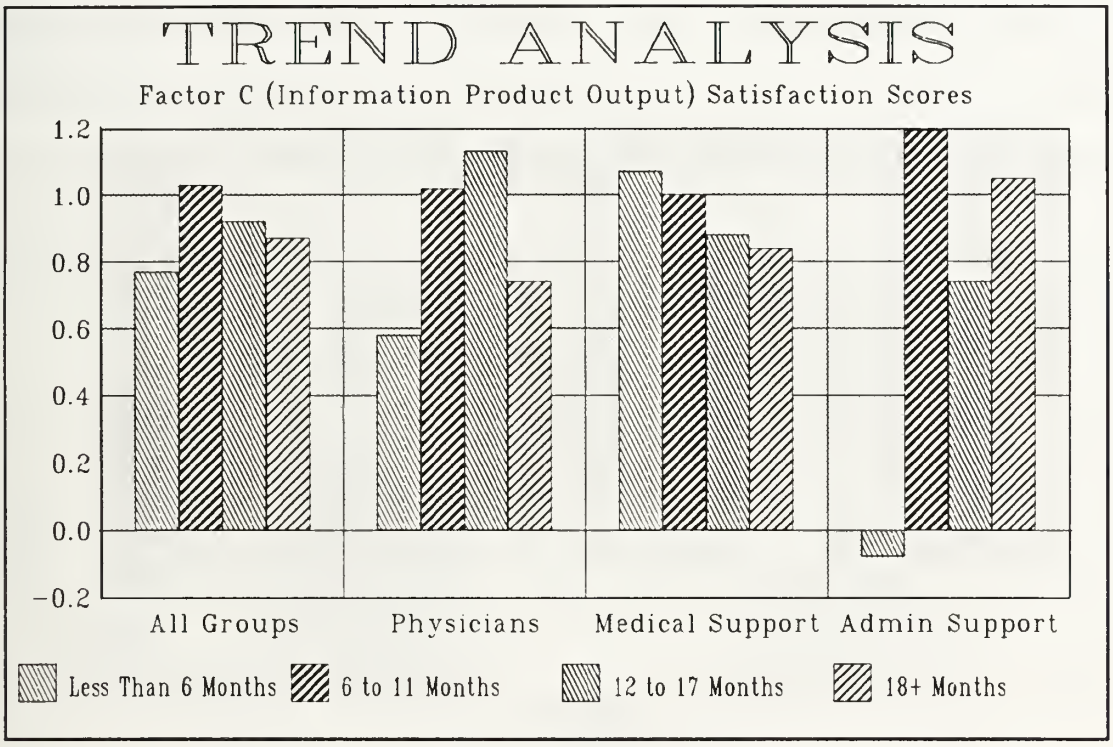

Figure 4.8. Trend Analysis Factor C

d. Factor D (User Knowledge and Involvement) Trends

Figure 4.9 shows the plotting of the six-month mean scores by All Groups combined as well as each of the individual user groups for Factor D (User Knowledge and Involvement) trends. This factor deals with an individual's perceptions of the training provided, understanding the system, and the degree the individual felt they were

participants in the system's development. The Physician user group appears to have a downward trend. This suggests that as physicians increase the time of use of the system, their level of satisfaction with understanding and being able to use the system diminishes. The Administrative Support user group appears to have an upward trend. This suggests that as administrative support personnel increase the time of use of the system, their level of satisfaction with understanding and being able to use the system increases.

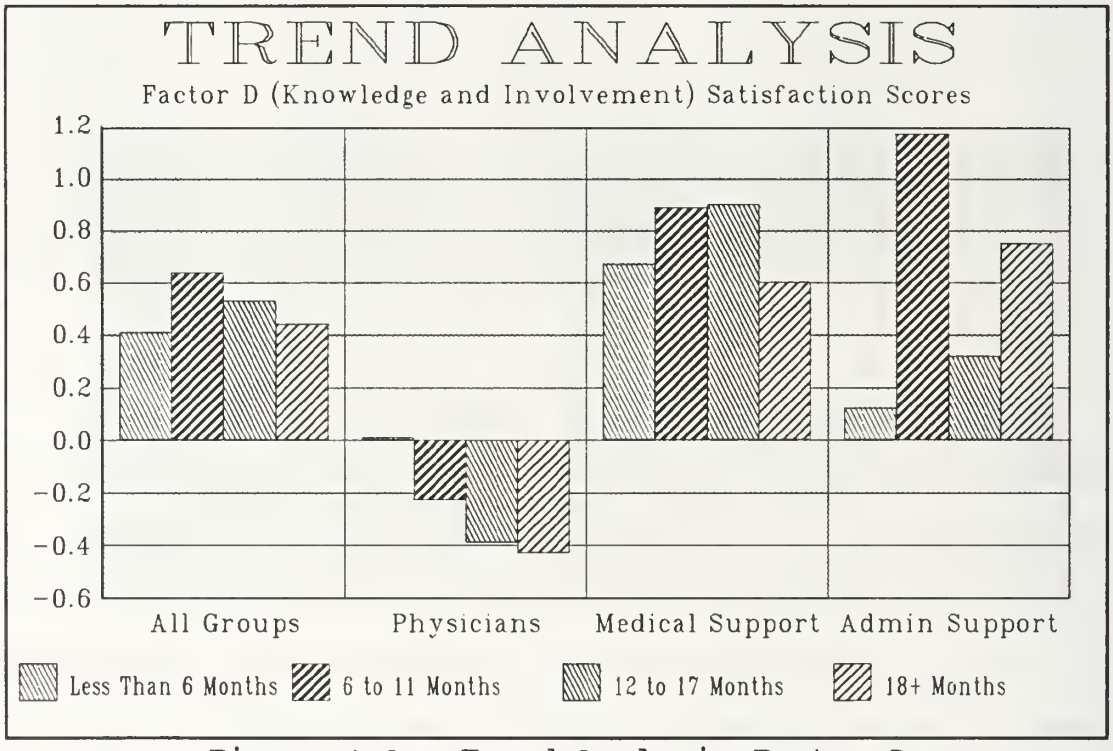

Figure 4.9. Trend Analysis Factor D

V. ANALYSIS OF FINDINGS

A. INTRODUCTION

It became apparent while conducting this study that the Baroudi and Orlikowski [2] short-form UIS instrument was inadequate to assess the overall user satisfaction level for the CHCS in this setting. As a result, the significance and reporting of the overall UIS scores have been purposely diminished. Rather, the reporting and analysis of the findings is more appropriately contained within the four factors found to summarize the 13 questions asked of the participants. As with any exploratory study, this small sampling is not intended to provide definitive results. Instead, the findings here are intended to provide insight and basis for further investigation. In discussing the findings, the intention will be to deal with more global issues.

In the first section, the homogeneity of the sample, responses, and structure of the short-form UIS instrument is discussed. This is important as stated earlier in this paper for it forms the foundation to be able to make the statements regarding the stability of the four factor structure, and in discussing differences without the influence of instrument bias. In the second section, the limitations confronting the current short-form UIS instrument and its impact on the

overall assessment of UIS is discussed. Thirdly, the survey findings of the three hospital data sampling will be discussed for distinctive differences and similarities between the three user groups. Lastly, the effect of length of time of use of the system on user satisfaction levels for the four factors will be discussed.

B. HOMOGENEITY OF SAMPLE AND RESPONSES

As expected, the sample data revealed a relatively homogenous group. The ANOVA testing essentially supports the homogeneity of the sample. Although there existed a significant difference in the median education level at Jacksonville ("bachelor degree" vs "some college" at the other two sites) on subsequent testing for correlation of education and the level of satisfaction revealed no significant correlation. Igbaria and Nachman [5] in their study found similar findings in that education was not correlated with user satisfaction. The same can be said essentially for the time of use of the system which will be amplified on later.

The homogeneity is further supported when equivalence testing for covariance and factor structure of the short-form UIS instrument responses was conducted. The finding of invariance between the three sites (subpopulations) for: 1) covariance, 2) four-factor structure, 3) factor loadings and pattern, 4) error/uniqueness, and 5) factor variance and covariances, demonstrates the stability of the new structure,

eliminates concerns about construct bias, and enhances the argument for homogeneity of the sample.

C. LIMITATIONS WITH THE CURRENT SHORT-FORM UIS INSTRUMENT

1. Factor Structure

The fundamental change of the current short-form UIS instrument from a three-factor construct to a four-factor construct seriously jeopardized its reliability and validity. The four-factor solution was tested and confirmed to be the stable form in this specific case. Interesting, the Ives et al.[3], 22 question survey construct factored into essentially the same four-factor identifiers (MID Staff and Services, Contractor Services, Information Product Output, and User Knowledge and Involvement) as found in this study. Ives et al.[3], eliminated the "vendor support" factor due to it only having one item loading into it.

Back when the Ives et al.[3] UIS instrument construct was developed, and later reduced to the current 13 question construct by Baroudi and Orlikowski [2], less emphasis was given to systems contracted out to external vendors. In the Department of Defense, more and more large-scale information systems development is being contracted out, as is the case with the CHCS.

With the four-factor construct there exists an internal reliability problem. Factor B (Contractor Services) suffers much the same problem encountered with the Ives et al.[3] study, in that too few items make up the factor. The

Cronbach alpha for Factor B was 0.68 which is below the minimum internal reliability of 0.70 that Nunnally [27] recommends. The rule of thumb for the number of items (or variables) per factor is that there must be at least three distinct variables [23][27]. Adding the question concerning vendor support from the Ives et al. [3] study would give Factor B the minimum three variables.

2. Weighting of Factors

The overall UIS score for the current short-form UIS instrument is determined by the sum of the 13 question's averaged scores. This is the correct procedure, however, unless each factor has the same number of questions (or variables) the overall UIS score is biased to that factor(s) with the most variables. The current short-form UIS instrument is heavily influenced by Factor C (Information Product Output) which has five questions making up this factor. Looking at the questions that make up Factor C, there exists redundancy. Questions 9 (Accuracy) and 10 (Precision) could be well served by question 7 (Reliability). A definition of question 7 could be offered to mean that the information product output is reliable, timely, accurate, and precise. The same holds for question 8 (Relevancy) which could be well served by question 13 (Completeness). This would reduce the emphasis on product output to two questions.

3. Information Product Output Factor

As Factor C's name implies, Information Product Output only deals with the system's outputs. An important assessment in dealing with user's perception of a system needs to address the user interface. If the system has a difficult user interface it is more likely that the user will understand the system less, and require more training in order for the user to become accustomed to the machine. The term "user-friendly" is used to denote a user interface that is logically designed with the user's needs, intuitively obvious, flexible, and offers on-line help. After talking with some of the users and seeing the system in operation, the user interface is an area of concern in this case. The user interface is an area not addressed by the current short-form UIS instrument. Feedback from users noted this omission. Interesting, the Ives et al.[3] survey had user interface (convenience of access) which had very high reliability correlations and factor loaded into their four-factor solution. Combining the user interface question along with the two output directed questions from above, would give Factor C three variables and equality with the other factors.

It should be noted that Factor D may be considered an indirect measure of "user-friendliness." Factor D deals with user's assessment of training, understanding, and involvement

with the system development. This issue will be further discussed in the next section.

D. SIGNIFICANT FACTOR DIFFERENCES BY USER GROUPS

Figure 5.1 shows the measure of user satisfaction by each of the four factors and the three user groups.

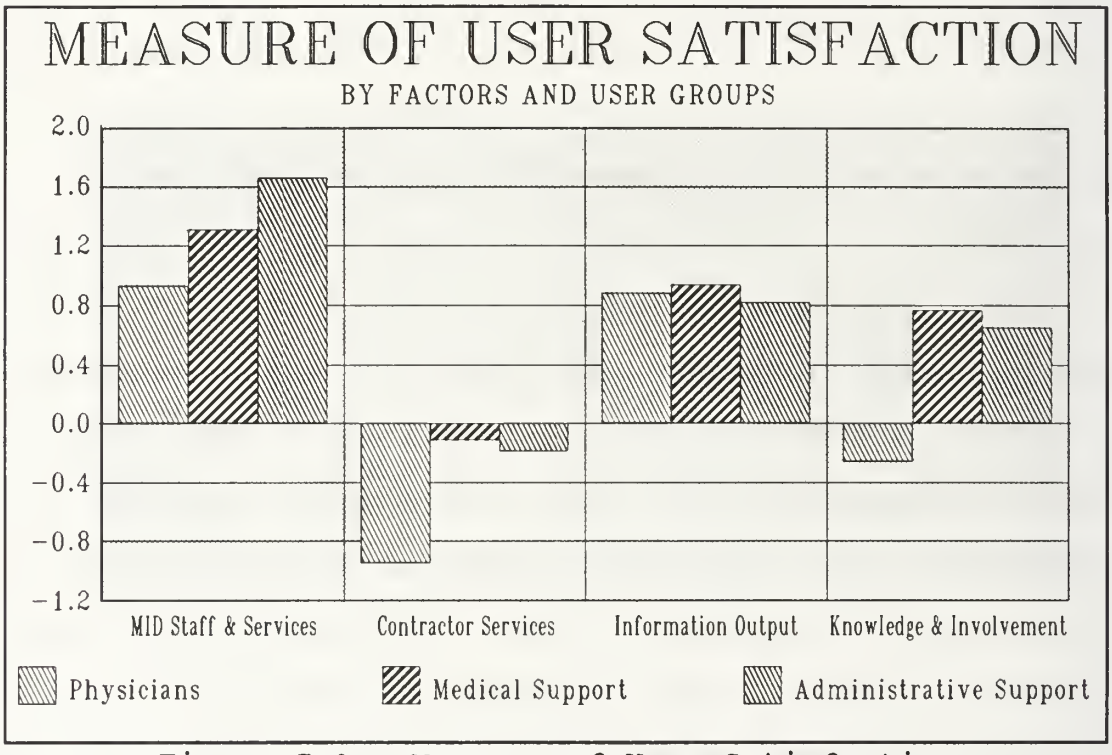

Figure 5.1. Measure of User Satisfaction

1. Factor A (MID Staff and Services)

Each of the user groups was satisfied with the local MID staff and services. This factor assesses the user's perception toward their relationship and the ability to communicate with the Management Information Department (MID). Although each of the user groups knows that the system is

being designed and implemented by an external vendor, all problems, change requests, and training is first handled through the local MID. The level of satisfaction tends to go up as the level of system interaction complexity goes down. That is to say, physicians were significantly less satisfied than the other two groups because their system interaction is the greatest and hence the greatest interaction with the local MID. Next is the Medical Support group, followed by the Administrative Support group with the least system routines to interact with. Figure 5.1 shows this stepping stone cascade effect.

2. Factor B (Contractor Services)

Each of the user groups was dissatisfied with the contractor's services. This factor assesses the user's perception toward the timeliness of incorporating changes to the system. The bureaucratic process for change in government contractual agreements can be lengthy. Bailey and Pearson [18] noted that the variables in this factor were ones that were the most frequently cited as causing dissatisfaction. With apparently all three user groups wanting the system to change, it brings to question the adequacy of the initial system's analysis and requirements process. To design a system "on the fly" through prototype-like software version updates, can lead to cost overruns and delays in delivery.

As mentioned above, Factor B's reliability alpha is below the minimum level desired for exploratory research.

Some caution is warranted. However, as can be seen in Figure 4.5 and questions 2 and 12 that make up Factor B, the results for Factor B are a good reflection of the user groups perceptions (no equally counter-balancing responses).

3. Factor C (Information Product Output)

Each of the user groups was satisfied with the information that the system produced. In fact, there is no significant difference between the three user groups as to their level of satisfaction as depicted in Figure 5.1. This factor asked the user's assessment of the system's information output for reliability, relevancy, accuracy, precision, and completeness.

4. Factor D (User Knowledge and Involvement)

This factor assesses the user's perception of the training received, their understanding of the system regarding the ability to use it, and their feeling of participation with the system's development. Physicians were significantly less satisfied than the two other groups. The Physicians were dissatisfied versus the Medical Support and Administrative Support groups reporting being satisfied. The system is designed to be driven by the Physician. As such, the Physician is given the widest access to the system's capabilities, and has the most incentive for wanting a user-friendly system. Unfortunately, the myriad of menus with limited on-line help makes the system in its current configuration difficult to use. The short-form UIS

instrument used in this study as already mentioned, does not directly assess the user interface. More training would only be a short-term resolve. Recurring training is difficult to schedule, and would require additional resources, adding to the cost of overhead maintenance for this system (i.e., for trainers, space for training, and time away from health care-related productivity). Strassmann [44] contends that sending users to classes, especially if this done entirely on the organization's time and at the organization's training center, is about the most expensive, least effective way of promoting the desired learning. He supports that the system should fit people, not the other way around [44].

E. TIME OF USE CORRELATION

The assumption held is that as the length of time of use of the system increased, the user's level of satisfaction would increase. This assumption is made in the belief that the user would realize with time and experience the benefits and efficiencies that the system should impart. The only significant correlation was for the Administrative Support group with Factor C (Information Product Output). The Administrative Support group exhibited a positive correlation with the system's output. There were no other significant correlations noted. This lack of correlation for the most part may be significant. It does say that a new user's level of satisfaction for that respective factor is essentially (statistically speaking) the same as a long-time user.

VI. CONCLUSION

The Composite Health Care System (CHCS) is a billion dollar military hospital information system venture currently being undertaken by the Department of Defense. The design and implementation of the CHCS is under contract to an external vendor. Good management practices deem assessment of effectiveness of any implementation effort. One of the most commonly used approaches to assess effectiveness of a computer-based information system is the surrogate measure of user's attitudes.

In this study, a commonly used, and previously validated 13 question short-form user information satisfaction (UIS) instrument developed by Baroudi and Orlikowski [2], was used to assess its ability to assess overall UIS for the CHCS. Baroudi and Orlikowski [2, p. 55] make it clear "that the short-form measure is not a universally applicable and immutable measure. It thus may be appropriate in various situations to modify the measure to more adequately reflect the requirements of the specific organization."

One of the important findings in this study is that the 13 question short-form UIS instrument is inadequate to assess the overall satisfaction of the CHCS. However, the information gained from its use, combined with further investigation can assist in the evaluation of effectiveness of the CHCS. The

use of a short-form UIS instrument can be a useful tool. When properly designed, it offers the information systems manager a quick and easy tool to assess areas of potential problems for further investigation.

A. CONCLUSIONS

1. Validation of the Short-Form UIS Instrument

As mentioned, the most important conclusion is that the 13 question short-form instrument is inadequate for evaluation of overall UIS. Limitations associated with a fundamental change in the factor structure due to the significant impact of contractor services, unevenly distributed variables in a couple of factors, low internal consistency coefficient in one factor, no assessment of user interaction with the system, and inconsistent convergent validity findings all contributed to the inadequacy of this instrument for the evaluation of overall UIS of the CHCS.

2. Areas of Satisfaction

All three user groups (Physicians, Medical Support, and Administrative Support) were satisfied with the local Management Information Department (MID) staff and services, as well as the information product output.

The Medical Support and the Administrative Support groups were satisfied with the training, understanding of the system, and level of participation.

3. Areas of Dissatisfaction

All three user groups were dissatisfied with the contractor services to accomplish change to the system. Physicians were dissatisfied with the training, understanding of the system, and the level of participation. Additionally, Physicians were statistically less satisfied than the other two user groups for local MID staff and services, contractor services, and for the training, understanding of the system, and level of participation.

4. Time of Use Correlation

The only significant correlation was the positive correlation exhibited by the Administrative Support group between the length of time of CHCS use and the information product output. There were no other significant correlations noted.

B. FUTURE RESEARCH

1. Re-design of the Short-form UIS Instrument

Based on the findings from this study, a 12 question (or variable) short-form UIS instrument, Appendix G, is suggested for future research investigation. In the demographics section, questions concerning education, age, gender, and previous computer use should be considered for elimination. Each of these user attributes have been found in a previous study [5], and for the most part supported by this study, not to correlate with UIS. In the questionnaire section, the use of an example to illustrate the scale

positions and their meanings would be highly beneficial for clarity. Baroudi and Orlikowski [2] offer a good example for use. A six interval Likert-type measurement scaling model vice the current seven interval model should be considered. Using a six interval model eliminates "neutral" responses without changing the scoring of the intervals (-3 to +3).

Referring to Appendix G, each of the four factors would have three questions associated with it. Factor A (MID Staff and Services) would be unchanged and be represented with the same questions (in this case, questions 1, 6, and 10). Factor B (Contractor Service) would consist of the same questions plus the added question about vendor support (questions 2, 8, and 11). Factor C (Information Input and Product) would consist of questions 7, 12, and the added question about "convenience of access" (question 9). Factor D (User Knowledge and Involvement) would be unchanged using questions 3, 4, and 5. Having equally distributed variables for each factor will prevent any one factor from biasing the overall score (which will now range from -36 to +36 vice -39 to +39 due to one less question).

Clarity of each question is important. Especially for the variable "convenience of access" where the emphasis is looking at the ease or difficulty with which the user may act to utilize the capability of the system. Bailey and Pearson [18] offer complete definitions for each of the questions. All of the current procedures described by Baroudi and

Orlikowski [2] for disseminating the instrument and ensuring confidentiality should be used.

a. Validation of the New Short-form Instrument

A large sampling of multiple hospitals (such as in this study) using the new short-form instrument will be necessary in order to validate the instrument. In addition to the methods used in this study (i.e., exploratory and confirmatory factor analysis, internal consistency testing, and equivalence testing), alternative forms of parallel tests (i.e., correlation with OT&E survey findings) or the split-half approach for estimates of reliability as described by Nunnally [27] should be used. Nunnally [27] does not recommend the retest method as an estimate of reliability as previous researchers have suggested. In addition, include sufficient time to allow a larger number of user interviews (minimum sample size of 20) for all three groups in order to conduct statistically meaningful convergent validity correlation study.

APPENDIX A

Part A: General Information

1. Hospital Department: (Check one)
   ____ General Administration
   ____ Nursing Administration
   ____ Dietary
   ____ Emergency
   ____ Laboratory
   ____ Outpatient Clinic
   ____ Outpatient Nursing
   ____ Pharmacy
   ____ Radiology
   ____ Other (Specify):_____

2. Job Description: (Check one)
   ____ Clerk
   ____ Corpsman (0000)
   ____ Technician
   ____ Nurse
   ____ Pharmacist
   ____ Physician
   ____ Physician Assistant
   ____ Other (Specify):_____

3. Highest Level of Education: (Check one)
   ____ High School Graduate
   ____ Some College
   ____ Bachelor's Degree
   ____ Some Graduate Work
   ____ Master's Degree
   ____ Doctoral Degree
   ____ Medical Degree
   ____ Other (Specify):_____

4. Age: ____ years

5. Gender: ____ Male ____ Female

6. Length of time (in months) you have used CHCS: ____

7. Have you used other computer systems before ? __ No __Yes
   If your answer was Yes, was it a health care

   information system ? ____ Yes ____ No

Part B: The Questionnaire

This section of the survey conveys your own personal feelings concerning the use of the Composite Health Care system at Naval Hospital, (LOCATION). Please do not attempt to analyze the questions. Remember, there are no right or wrong answers.

Please follow these instructions:

a. Check each scale in the position that describes your evaluation of the factor being described.

b. Check each scale, do not omit any.

c. Check only one position for each scale.

d. Check in the space, not between spaces. THIS, **NOT THIS**
:_X_: ___X___:

e. Work rapidly. Rely on your first impressions.

The scale positions are defined as follows:

adjective X :___:___:___:___:___:___:___: adjective Y
(1) (2) (3) (4) (5) (6) (7)

(1) extremely X
(2) quite X
(3) slightly X
(4) neither X or Y; equally X or Y; does not apply
(5) slightly Y
(6) quite Y
(7) extremely Y

ANSWERS BASED ON YOUR OWN FEELINGS

1. Relationship with the Management Information Department (MID) staff

dissonant :___:___:___:___:___:___:___: harmonious

bad :___:___:___:___:___:___:___: good

2. Processing of requests for changes to existing systems

fast :___:___:___:___:___:___:___: slow

untimely :___:___:___:___:___:___:___: timely

3. Degree of training provided to users

complete :___:___:___:___:___:___:___: incomplete

low :___:___:___:___:___:___:___: high

4. Your understanding of systems

insufficient :___:___:___:___:___:___:___: sufficient

complete :___:___:___:___:___:___:___: incomplete

5. Your feeling of participation

positive :___:___:___:___:___:___:___: negative

insufficient :___:___:___:___:___:___:___: sufficient

6. Attitude of the Management Information Department staff

cooperative :___:___:___:___:___:___:___: belligerent

negative :___:___:___:___:___:___:___: positive

7. Reliability of output information

high :___:___:___:___:___:___:___: low

superior :___:___:___:___:___:___:___: inferior

8. Relevancy of output information to intended function (degree of what user wants or requires and what is provided by the system)

useful :___:___:___:___:___:___:___: useless

relevant :___:___:___:___:___:___:___: irrelevant

9. Accuracy of output information

inaccurate :___:___:___:___:___:___:___: accurate

low :___:___:___:___:___:___:___: high

10. Precision of output information (the variability of the output information from that which it purports to measure)

low :___:___:___:___:___:___:___: high

definite :___:___:___:___:___:___:___: uncertain

11. Communication with the Management Information Department staff

dissonant :___:___:___:___:___:___:___: harmonious

destructive :___:___:___:___:___:___:___: productive

12. Time required for new systems development

unreasonable :___:___:___:___:___:___:___: reasonable

acceptable :___:___:___:___:___:___:___: unacceptable

13. Completeness of the output information

sufficient :___:___:___:___:___:___:___: insufficient

adequate :___:___:___:___:___:___:___: inadequate

Thank you for your cooperation

APPENDIX B

Exploratory Factor Analysis SAS Commands:

```
libname dataname "a:\";
title "CHCS UIS using Baroudi Short-Form Questionaire";
title2 "CHCS (3 hospitals combined) Factor Analysis";
option linesize=80;
options pagesize=58;
data dataname.dat (keep=Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13);
     infile "A:\FA-CHCS.DAT";
     input Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13;
proc factor method=ml
     msa /* Kaiser Measure of Sampling Adequacy - Sphericity */
     scree
     heywood
     n=1
     rotate=varimax
     reorder;
     title3 "Maximum Likeliness Factor Analysis with One Factor";
proc factor method=ml
     heywood
     n=2
     rotate=varimax
     reorder;
     title3 "Maximum Likeliness Factor Analysis with Two Factors";
proc factor method=ml
     heywood
     n=3
     rotate=varimax
     reorder;
     title3 "Maximum Likeliness Factor Analysis with Three Factors";
proc factor method=ml
     heywood
     n=4
     rotate=varimax
     reorder;
     title3 "Maximum Likeliness Factor Analysis with Four Factors";
proc factor method=ml
     heywood
     n=5
     rotate=varimax
     reorder;
     title3 "Maximum Likeliness Factor Analysis with Five Factors";
proc standard mean=0 std=1 out=stdized;
     title3 "CHCS data set Standardized with Mean=0 and STD=1";
proc factor method=ml data=work.stdized
     heywood
     n=3
     rotate=varimax
     reorder;
     title3   "Max-Likeliness   Factor   Analysis   w/3   Factors
```

```
(Standardized)";
proc factor method=ml data=work.stdized
     heywood
     n=4
     rotate=varimax
     reorder;
     title3   "Max-Likeliness   Factor   Analysis   w/4   Factors
(Standardized)";
proc factor method=ml data=work.stdized
     heywood
     n=5
     rotate=varimax
     reorder;
     title3   "Max-Likeliness   Factor   Analysis   w/5   Factors
(Standardized)";
run;
```

APPENDIX C

Confirmatory Factor Analysis:

PRELIS Commands:

```
CHCS (3 hospitals combined) Factor Analysis Confirmation by
LISREL
DA NI=13
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
RA FI=A:\FA-CHCS.DAT
OR ALL
OU MA=PM SM=A:\CHCS.PML SA=A:\CHCS.ACP PA
```

LISREL Commands:

```
FA of Ordinal Variables Confirmation by LISREL: 3 Hosps
Combined
DA NI=13 NO=340 MA=PM
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
PM FI=A:\CHCS.PML
AC FI=A:\CHCS.ACP
MO NX=13 NK=4 PH=ST
LK
FACTOR_A FACTOR_B FACTOR_C FACTOR_D
FR LX 1 1 LX 6 1 LX 11 1 continued
   LX 2 2 LX 12 2 continued
   LX 7 3 LX 8 3 LX 9 3 LX 10 3 LX 13 3 continued
   LX 3 4 LX 4 4 LX 5 4
OU SE TV
```

APPENDIX D

Cronbach's Reliability Testing SAS Commands:

```
libname dataname "a:\";
title "CHCS UIS using Baroudi Short-Form Questionaire";
title2 "CHCS (3 hospitals combined) Factor Analysis";
title3 "Cronbach alphas on factor clusters";
options linesize=80;
options pagesize=58;
data dataname.dat (keep=Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12
                       Q13);
     infile "a:\FA-CHCS.dat";
     input Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13;
proc corr alpha;
     var Q7 Q8 Q9 Q10 Q13;
proc corr alpha;
     var Q1 Q6 Q11;
proc corr alpha;
     var Q3 Q4 Q5;
proc corr alpha;
     var Q2 Q12;
run;
```

APPENDIX E

Equivalence Testing PRELIS/LISREL Commands:

PRELIS Commands:

```
PRELIS covariance matrix for Charleston Hospital
DA NI=13
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
RA FI=A:\FA-CHAR.DAT
OR ALL
OU MA=CM SM=A:\CHAR-LIS.CMX

PRELIS covariance matrix for Camp Lejeune Hospital
DA NI=13
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
RA FI=A:\FA-CLEJ.DAT
OR ALL
OU MA=CM SM=A:\CLEJ-LIS.CMX

PRELIS covariance matrix for Jacksonville Hospital
DA NI=13
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
RA FI=A:\FA-JAX.DAT
OR ALL
OU MA=CM SM=A:\JAX-LIS.CMX
```

LISREL Commands:

```
HYPOTHESIS A, LOCATION: NH CHARLESTON
DA NG=3 NI=13 NO=101
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CHAR-LIS.CMX
MO NX=13 NK=13 LX=ID TD=ZE
OU
HYPOTHESIS A, LOCATION: NH CAMP LEJEUNE
DA NO=121
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CLEJ-LIS.CMX
MO PH=IN
OU
HYPOTHESIS A, LOCATION: NH JACKSONVILLE
DA NO=118
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\JAX-LIS.CMX
MO PH=IN
```

```
OU

HYPOTHESIS B, LOCATION: NH CHARLESTON
DA NG=3 NI=13 NO=101
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CHAR-LIS.CMX
MO NX=13 NK=4
FR LX 8 1 LX 9 1 LX 10 1 LX 13 1 continued
   LX 2 2 continued
   LX 1 3 LX 6 3 continued
   LX 3 4 LX 4 4
VA 1 LX 7 1  LX 12 2 LX 11 3 LX 5 4
OU
HYPOTHESIS B, LOCATION: NH CAMP LEJEUNE
DA NO=121
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CLEJ-LIS.CMX
MO LX=PS
OU
HYPOTHESIS B, LOCATION: NH JACKSONVILLE
DA NO=118
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\JAX-LIS.CMX
MO LX=PS
OU

HYPOTHESIS C, LOCATION: NH CHARLESTON
DA NG=3 NI=13 NO=101
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CHAR-LIS.CMX
MO NX=13 NK=4
FR LX 8 1 LX 9 1 LX 10 1 LX 13 1 continued
   LX 2 2 continued
   LX 1 3 LX 6 3 continued
   LX 3 4 LX 4 4
VA 1 LX 7 1 LX 12 2 LX 11 3 LX 5 4
OU
HYPOTHESIS C, NH CAMP LEJEUNE
DA NO=121
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CLEJ-LIS.CMX
MO LX=IN
OU
HYPOTHESIS C, LOCATION: NH JACKSONVILLE
DA NO=118
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
```

```
CM FI=A:\JAX-LIS.CMX
MO LX=IN
OU

HYPOTHESIS D, LOCATION: NH CHARLESTON
DA NG=3 NI=13 NO=101
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CHAR-LIS.CMX
MO NX=13 NK=4
FR LX 8 1 LX 9 1 LX 10 1 LX 13 1 continued
   LX 2 2 continued
   LX 1 3 LX 6 3 continued
   LX 3 4 LX 4 4
VA 1 LX 7 1 LX 12 2 LX 11 3 LX 5 4
OU
HYPOTHESIS D, LOCATION: NH CAMP LEJEUNE
DA NO=121
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CLEJ-LIS.CMX
MO LX=IN TD=IN
OU
HYPOTHESIS D, LOCATION: NH JACKSONVILLE
DA NO=118
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\JAX-LIS.CMX
MO LX=IN TD=IN
OU

HYPOTHESIS E, LOCATION: NH CHARLESTON
DA NG=3 NI=13 NO=101
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CHAR-LIS.CMX
MO NX=13 NK=4
FR LX 8 1 LX 9 1 LX 10 1 LX 13 1 continued
   LX 2 2 continued
   LX 1 3 LX 6 3 continued
   LX 3 4 LX 4 4
VA 1 LX 7 1 LX 12 2 LX 11 3 LX 5 4
OU
HYPOTHESIS E, LOCATION: NH CAMP LEJEUNE
DA NO=121
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\CLEJ-LIS.CMX
MO LX=IN TD=IN PH=IN
OU
HYPOTHESIS E, LOCATION: NH JACKSONVILLE
DA NO=118
```

```
LA
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13
CM FI=A:\JAX-LIS.CMX
MO LX=IN TD=IN PH=IN
OU
```

APPENDIX F

CHCS - COMBINED 3 HOSPITAL DATA
SHORT-FORM UIS INSTRUMENT OVERALL STATISTICS

TOTAL NUMBER OF SURVEYS:	340		
RESPONSE RATE (680 SENT)	50%		
MEDIAN EDUCATION LEVEL:	1	Some College	
AVERAGE AGE:	32	years	
MINIMUM AGE:	18	years	
MAXIMUM AGE:	61	years	
NUMBER OF MALES:	213		
NUMBER OF FEMALES:	127		
PERCENT MALES:	63%		
PERCENT FEMALES:	37%		
AVERAGE MONTHS USED:	12.3		
MIN MONTHS USED:	1		
MAX MONTHS USED:	36		
NUMBER USED COMPUTER BEFORE	271		
PERCENT USED BEFORE:	80%		
NUMBER USED HLT CARE COMPTR	200		
PERCENT USED HC COMP BEFORE	59%		
PERCENT USED BEFORE AND USED HC SYSTEM BEFORE	74%		
NO. PERSN MONTHS USE 1-5:	67	20%	
NO. PERSN MONTHS USE 6-11:	98	29%	
NO. PERSN MONTHS USE 12-17:	81	24%	
NO. PERSN MONTHS USE 18 >:	94	28%	

	QUEST 1	QUEST 2	QUEST 3	QUEST 4	QUEST 5	QUEST 6
AVERAGE	1.27	-0.41	0.15	0.72	0.68	1.43
STD DEV	1.29	1.62	1.73	1.68	1.57	1.30
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 7	QUEST 8	QUEST 9	QUEST 10	QUEST 11	QUEST 12
AVERAGE	1.00	0.93	1.16	0.75	1.14	-0.23
STD DEV	1.42	1.41	1.38	1.32	1.36	1.67
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 13	OVERALL
AVERAGE	0.69	9.26
STD DEV	1.53	12.77
MIN NUMBR	-3	-28
MAX NUMBR	3	39

	MID STAFF/SERV FACTOR A (1,6,11)	CONTRACTOR STAFF/SERV FACTOR B (2,12)	INFORMATION PRODUCT FACTOR C (7,8,9,10,13)	KNOWLEDGE & INVOLVEMENT FACTOR D (3,4,5)
AVERAGE	1.28	-0.32	0.91	0.51
STD DEV	1.19	1.43	1.15	1.35
MIN NUMBR	-3	-3	-3	-3
MAX NUMBR	3	3	3	3

NAVAL HOSPITAL CHARLESTON, SC
CHCS, SHORT-FORM UIS INSTRUMENT STATISTICS

TOTAL NUMBER OF SURVEYS:	101	
RESPONSE RATE (180 SENT):	56%	
MEDIAN EDUCATION LEVEL:	Some college	
AVERAGE AGE:	32 years	
MINIMUM AGE:	19 years	
MAXIMUM AGE:	56 years	
NUMBER OF MALES: (Percent)	57 (56%)	
NUMBER OF FEMALES:	44 (44%)	
AVERAGE MONTHS USED:	8.6	
MIN MONTHS USED:	1	
MAX MONTHS USED:	19	
NUMBER USED COMPUTER BEFORE	83	
PERCENT USED BEFORE:	82%	
NUMBER USED HLT CARE COMPTR	59	
PERCENT USED HC COMP BEFORE	58%	
PERCENT USED COMP BEFORE AND USED HC SYSTEM BEFORE:	71%	
NO. PERSN MONTHS USE 1-5:	28	28%
NO. PERSN MONTHS USE 6-11:	36	36%
NO. PERSN MONTHS USE 12 >:	37	36%

	QUEST 1	QUEST 2	QUEST 3	QUEST 4	QUEST 5	QUEST 6
AVERAGE	1.68	-0.50	0.57	0.97	1.07	1.99
STD DEV	1.22	1.67	1.72	1.60	1.57	1.00
MIN NUMBR	-2	-3	-3	-3	-3	-1.5
MAX NUMBR	3	3	3	3	3	3

	QUEST 7	QUEST 8	QUEST 9	QUEST 10	QUEST 11	QUEST 12
AVERAGE	0.79	0.96	1.17	0.54	1.65	-0.22
STD DEV	1.47	1.39	1.50	1.43	1.14	1.64
MIN NUMBR	-3	-3	-3	-3	-0.5	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 13	OVERALL
AVERAGE	0.59	11.26
STD DEV	1.44	11.80
MIN NUMBR	-3	-13.5
MAX NUMBR	3	39

	MID STAFF/SERV FACTOR A (1,6,11)	CONTRACTOR STAFF/SERV FACTOR B (2,12)	INFORMATION PRODUCT FACTOR C (7,8,9,10,13)	KNOWLEDGE & INVOLVEMENT FACTOR D (3,4,5)
AVERAGE	1.77	-0.36	0.81	0.87
STD DEV	0.99	1.34	1.17	1.25
MIN NUMBR	-1	-3	-3	-2
MAX NUMBR	3	3	3	3

NAVAL HOSPITAL CAMP LEJEUNE, NC
CHCS, SHORT-FORM UIS INSTRUMENT STATISTICS

TOTAL NUMBER OF SURVEYS:	121	
RESPONSE RATE (250 SENT):	48%	
MEDIAN EDUCATION LEVEL:	Some college	
AVERAGE AGE:	33 years	
MINIMUM AGE:	18 years	
MAXIMUM AGE:	61 years	
NUMBER OF MALES: (Percent)	73 (60%)	
NUMBER OF FEMALES: (Percent)	48 (40%)	
AVERAGE MONTHS USED:	12.5	
MIN MONTHS USED:	1	
MAX MONTHS USED:	36	
NUMBER USED COMPUTER BEFORE	92	
PERCENT USED BEFORE:	76%	
NUMBER USED HLT CARE COMPTR	63	
PERCENT USED HC COMP BEFORE	52%	
PERCENT USED BEFORE AND USED HC SYSTEM BEFORE	68%	
NO. PERSN MONTHS USE 1-5:	21	17%
NO. PERSN MONTHS USE 6-11:	44	37%
NO. PERSN MONTHS USE 12-17:	27	27%
NO. PERSN MONTHS USE 18 >:	29	29%

	QUEST 1	QUEST 2	QUEST 3	QUEST 4	QUEST 5	QUEST 6
AVERAGE	1.44	0.19	0.44	0.67	0.84	1.63
STD DEV	1.27	1.41	1.68	1.82	1.48	1.30
MIN NUMBR	-2	-3	-3	-3	-3	-1.5
MAX NUMBR	3	3	3	3	3	3

	QUEST 7	QUEST 8	QUEST 9	QUEST 10	QUEST 11	QUEST 12
AVERAGE	1.28	1.16	1.38	0.86	1.31	0.14
STD DEV	1.29	1.35	1.26	1.29	1.39	1.57
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 13	OVERALL
AVERAGE	0.94	12.28
STD DEV	1.46	12.41
MIN NUMBR	-3	-25
MAX NUMBR	3	39

	MID STAFF/SERV FACTOR A (1,6,11)	CONTRACTOR STAFF/SERV FACTOR B (2,12)	INFORMATION PRODUCT FACTOR C (7,8,9,10,13)	KNOWLEDGE & INVOLVEMENT FACTOR D (3,4,5)
AVERAGE	1.46	0.17	1.12	0.65
STD DEV	1.17	1.32	1.07	1.38
MIN NUMBR	-1	-3	-3	-3
MAX NUMBR	3	3	3	3

NAVAL HOSPITAL JACKSONVILLE, FL
CHCS, SHORT-FORM UIS INSTRUMENT STATISTICS

TOTAL NUMBER OF SURVEYS:	118	
RESPONSE RATE (250 SENT):	47%	
MEDIAN EDUCATION LEVEL:	BACHELOR DEGREE	
AVERAGE AGE:	32 YEARS	
MINIMUM AGE:	19 YEARS	
MAXIMUM AGE:	56 YEARS	
NUMBER OF MALES: (Percent)	83 (70%)	
NUMBER OF FEMALES: (Percent)	35 (30%)	
AVERAGE MONTHS USED:	15.3	
MIN MONTHS USED:	1	
MAX MONTHS USED:	32	
NUMBER USED COMPUTER BEFORE	102	
PERCENT USED BEFORE:	86%	
NUMBER USED HLT CARE COMPTR	78	
PERCENT USED HC COMP BEFORE	66%	
PERCENT USED BEFORE AND USED HC SYSTEM BEFORE	76%	
NO. PERSN MONTHS USE 1-5:	18	15%
NO. PERSN MONTHS USE 6-11:	18	15%
NO. PERSN MONTHS USE 12-17:	22	19%
NO. PERSN MONTHS USE 18 >:	60	51%

	QUEST 1	QUEST 2	QUEST 3	QUEST 4	QUEST 5	QUEST 6
AVERAGE	0.74	-0.94	-0.53	0.56	0.17	0.74
STD DEV	1.22	1.57	1.60	1.58	1.55	1.23
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 7	QUEST 8	QUEST 9	QUEST 10	QUEST 11	QUEST 12
AVERAGE	0.89	0.67	0.94	0.81	0.52	-0.63
STD DEV	1.47	1.47	1.36	1.22	1.25	1.72
MIN NUMBR	-3	-3	-3	-3	-3	-3
MAX NUMBR	3	3	3	3	3	3

	QUEST 13	OVERALL
AVERAGE	0.52	4.46
STD DEV	1.66	12.63
MIN NUMBR	-3	-28
MAX NUMBR	3	36

	MID STAFF/SERV FACTOR A (1,6,11)	CONTRACTOR STAFF/SERV FACTOR B (2,12)	INFORMATION PRODUCT FACTOR C (7,8,9,10,13)	KNOWLEDGE & INVOLVEMENT FACTOR D (3,4,5)
AVERAGE	0.67	-0.79	0.77	0.07
STD DEV	1.13	1.47	1.19	1.30
MIN NUMBR	-3	-3	-3	-3
MAX NUMBR	3	3	3	3

APPENDIX G
Part A: General Information

1. Hospital Department: (Check one)
   _____ General Administration
   _____ Nursing Administration
   _____ Dietary
   _____ Emergency
   _____ Laboratory
   _____ Outpatient Clinic
   _____ Outpatient Nursing
   _____ Pharmacy
   _____ Radiology
   _____ Other (Specify):_____

2. Job Description: (Check one)
   _____ Clerk
   _____ Corpsman (0000)
   _____ Technician
   _____ Nurse
   _____ Pharmacist
   _____ Physician
   _____ Physician Assistant
   _____ Other (Specify):_____

3. Length of time (in months) you have used CHCS: _____

==========

Part B: The Questionnaire

This section of the survey conveys your own personal feelings concerning the use of the Composite Health Care system at Naval Hospital, (LOCATION). Please do not attempt to analyze the questions. Remember, there are no right or wrong answers.

Please follow these instructions:

a. Check each scale in the position that describes your evaluation of the factor being described.
b. Check each scale, do not omit any.
c. Check only one position for each scale.
d. Check in the space, not between spaces.
e. Work rapidly. Rely on your first impressions.

	THIS,	**NOT THIS**
	:_X_:	____X___:

The scale positions are defined as follows:

adjective X :___:___:___:___:___:___: adjective Y
(1) (2) (3) (4) (5) (6)

(1) extremely X
(2) quite X
(3) slightly X
(4) slightly Y
(5) quite Y
(6) extremely Y

The following example illustrates the scale positions and their meanings:

My vacation in the Bahamas was:

restful :___:___:___:___:___:_X_: hectic

healthy :___:_X_:___:___:___:___: unhealthy

According to the responses, the person's vacation was extremely hectic and quite healthy

ANSWERS BASED ON YOUR OWN FEELINGS

1. Relationship with the Management Information Department (MID) staff

dissonant :___:___:___:___:___:___: harmonious

bad :___:___:___:___:___:___: good

2. Processing of requests for changes to existing system

fast :___:___:___:___:___:___: slow

untimely :___:___:___:___:___:___: timely

3. Degree of training provided to you

complete :___:___:___:___:___:___: incomplete

low :___:___:___:___:___:___: high

4. Your understanding of the system

insufficient :___:___:___:___:___:___: sufficient

complete :___:___:___:___:___:___: incomplete

5. Your feeling of participation

positive :___:___:___:___:___:___: negative

insufficient :___:___:___:___:___:___: sufficient

6. Attitude of the Management Information Department staff

cooperative :___:___:___:___:___:___: belligerent

negative :___:___:___:___:___:___: positive

7. Reliability of output information (that the output is reliable, timely, accurate, and precise)

high :___:___:___:___:___:___: low

superior :___:___:___:___:___:___: inferior

8. Vendor Support (the type and quality of the service rendered by the vendor)

sufficient :___:___:___:___:___:___:___: insufficient

poor :___:___:___:___:___:___:___: good

9. Convenience of access (the ease or difficulty that you have to utilize the capability of the system)

easy :___:___:___:___:___:___:___: difficult

efficient :___:___:___:___:___:___:___: inefficient

10. Communication with the Management Information Department staff

dissonant :___:___:___:___:___:___:___: harmonious

destructive :___:___:___:___:___:___:___: productive

11. Time required for new system development

unreasonable :___:___:___:___:___:___:___: reasonable

acceptable :___:___:___:___:___:___:___: unacceptable

12. Completeness of the output information

sufficient :___:___:___:___:___:___:___: insufficient

adequate :___:___:___:___:___:___:___: inadequate

Thanks again for your cooperation

REFERENCES

[1] Hurd, L.E., *Evaluation of User Information Satisfaction of the Composite Health Care System*, Master's Thesis, Naval Postgraduate School, Monterey, California, March 1991.

[2] Baroudi, J. and Orlikowski, W., "A Short-Form Measure of User Information Satisfaction: A Psychometric Evaluation and Notes for Use," Journal of Management Information Systems, Vol. 4, No. 4, Spring 1988, pp. 44-59.

[3] Ives, B., Olson, M., and Baroudi, J., "The Measurement of User Information Satisfaction. Communications of the ACM, Vol. 26, No. 10, October 1983, pp. 785-792.

[4] Ives, B. and Olson, M.H., "User Involvement and MIS Success: A Review of Research," Management Science, Vol. 30, No. 5, May 1984, pp. 586-603.

[5] Igbaria, M., and Nachman, S.A., "Correlates of user satisfaction with end user computing: An exploratory study," Information & Management, Vol. 19, No. 2, November 1990, pp. 73-82.

[6] Neumann, S. and Segev, E., "Evaluate Your Information System," Journal of Systems Management, Vol. 31, No. 3, March 1980, pp. 34-41.

[7] Powers, R.F. and Dickson, G.W., "MisProject Management: Myths, Opinions, and Reality," California Management Review, Vol. 15, No. 3, Spring 1973, pp. 147-156.

[8] Galletta, D.F., and Lederer, A.L., "Some Cautions on the Measurement of User Information Satisfaction," Decision Sciences, Vol. 20, No. 3, Summer 1989, pp. 419-438.

[9] Davis, D.D., "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," MIS Quarterly, Vol. 13, No. 3, September 1989, pp. 319-339.

[10] Nolan, R.L., and Seward, H.H., *Measuring information user satisfaction to evaluate systems*. In R.L. Nolan (Ed), Managing the Data Resource Function, West Publishing Co., 1974.

[11] Ein-Dor, P. and Segev, E. "Organizatinal Context and the Success of Management Information Systems," Management Science, Vol. 24, No. 10, June 1978, pp. 1064-1077.

[12] King, W.R. and Rodriquez, J.I. "Evaluating Management Information Systems," MIS Quarterly, Vol. 2, No. 3, September 1978, pp. 43-51.

[13] King, J.L. and Schrems, E.L. "Cost-Benefits Analysis in IS Development and Operation," Computing Surveys, Vol. 10, No. 1, March 1978, pp. 19-34.

[14] Maish, A.M. "A User's Behavior Toward His MIS," MIS Quarterly, Vol. 3, No. 1, March 1979, pp. 39-52.

[15] Kleijnen, J.P.C. *Computers and Profits: Quantifying Financial Benefits of Information*, Addison-Wesley, Reading, Massachusetts, 1980.

[16] Nigam, R. and Hong, S. "Analytical Hierarchy Process Applied to the Evaluation of Financial Modeling Software," Proceedings of the DSS-81 Conference, Atlanta, Georgia, 1981.

[17] Epstein, B.J. and King, W.R. "An Experimental Study of the Value of Information," OMEGA, Vol. 10, No. 3, September 1982, pp. 249-258.

[18] Bailey, J.E., and Pearson, S.W., "Development of a Tool for Measuring and Analyzing Computer User Satisfaction," Management Science, Vol. 29, No. 5, May 1983, pp. 530-543.

[19] Hamilton, S., and Chervany, N.L., "Evaluating Information System Effectiveness - Part 1: Comparing Evaluation Approaches," MIS Quarterly, Vol. 5, No. 3, September 1981, pp. 55-69.

[20] Conrath, D.W., and Mignen, O.P., "What is being done to measure user satisfaction with EDP/MIS," Information & Management, Vol. 19, No. 1, August 1990, pp. 7-19.

[21] Swanson, E.B., "Management Information Systems: Appreciation and Involvement," Management Science, Vol. 21, No. 2, October 1974, pp. 178-188.

[22] Ghani, J.A., and Al-Meer, A.R., "Effect of End-User Computing on Job Satisfaction: An Exploratory Study," Information & Management, Vol. 17, No. 4, 1989, pp. 191-195.

[23] Etezadi-Amoli, J., and Farhoomand, A.F., "On End-User Computing Satisfaction," MIS Quarterly, Vol. 15, No. 1, March 1991, pp. 1-4.

[24] Doll, W.J., and Torkzadeh, G., "The Measurement of End-User Computing Satisfaction: Theoretical and Methodological Issue," MIS Quarterly, Vol. 15, No. 1, March 1991, pp. 5-10.

[25] Cerullo, M.J., Information systems success factors. Journal of Systems Management, 1980, Vol. 31, No. 12, pp. 10-19.

[26] Lawler, E.E., and Wanous, J.P., "Measurement and Meaning of Job Satisfaction," Journal of Applied Psychology, Vol. 56, No. 2, April 1972, pp. 95-105.

[27] Nunnally, J.C., *Psychometric Theory, 2nd Edition*, McGraw-Hill Publishing Co., New York, 1978.

[28] United States General Accounting Office, Report to the Chairmen, Senate and House Committees on Armed Services, Medical ADP Systems, "Composite Health Care: Defense Faces a Difficult Task," GAO/IMTEC-90-42, March 1990.

[29] Director, Medical Service Corps, Unclassified Memorandum for All Medical Service Corps Officers, 6555, Ser 00MSC/0144, Subject: Medical Service Corps Newsletter/Career Information, July 1990, pp. 13-15.

[30] Schaefer, R.L., and Anderson, R.B., *The Student Edition of MINITAB User's Manual*, Addison-Wesley Publishing Company, Inc., Reading Massachusetts, 1989.

[31] Zehna, P.W., *A MINITAB Companion for Probability and Statistics*, prepublication manuscript copy, Addison-Wesley Publishing Company, Reading Massachusetts, 1990.

[32] Dillon, W.R., and Goldstein, M., *Multivariate Analysis Methods and Applications*, John Wiley & Sons Inc., New York, 1984.

[33] SAS Institute Inc., SAS/STAT Users Guide, Version 6, 4th Edition, Vol. 1, Cary, NC: SAS Institute Inc., 1989.

[34] Stewart, D.W., The Application and Misapplication of Factor Analysis in Marketing Research, Journal of Marketing Research, Vol. XVIII, February 1981, pp. 51-62.

[35] Mulaik, S.A., James, L.R., Van Alstine, J. Bennett, N., Lind, S., and Stilwell C. D., "Evaluation of Goodness-of-Fit Indices for Structural Equation Models", Psychological Bulletin, Vol. 105, No. 3, 1989, pp. 430-445.

[36] Bentler, P.M., and Bonett, D.G., "Significance Tests and Goodness of Fit in the Analysis of Covariance Structures", Psychological Bulletin, Vol. 88, No. 3, 1980, pp. 588-606.

[37] Byrne, B.M., Shavelson, R.J., and Muthén, B., "Testing for the Equivalence of Factor Covariance and Mean Structures: The Issue of Partial Measurement Invariance", Psychological Bulletin, Vol. 105, No. 3, 1989, pp. 456-468.

[38] Marsh, H.W., and Hocevar, D., "Application of Confirmatory Factor Analysis to the Study of Self-Concept: First- and Higher Order Factor Models and Their Invariance Across Groups", Psychological Bulletin, Vol. 97, No. 3, 1985, pp. 562-582.

[39] Jöreskog, K.G. and Sörbom, D., *LISREL 7, A Guide to the Program and Applications, 2nd Edition*, SPSS Inc., Chicago, Illinois, 1988.

[40] Jöreskog, K.G. and Sörbom, D., PRELIS, Scientific Software, Inc., Mooresville, Indiana, 1981-1988.

[41] SAS Institute Inc., SAS Procedures Guide, Version 6, 3rd Edition, Cary, NC: SAS Institute Inc., 1990.

[42] Drasgow, F., and Kanfer, R., "Equivalence of Psychological Measurement in Heterogeneous Populations", Journal of Applied Psychology, Vol. 70, No. 4, 1985, pp. 662-680.

[43] Bollen, K.A., *Structural Equations with Latent Variables*, John Wiley & Sons Inc., New York, 1989.

[44] Strassmann, P.A. *Information Payoff, The Transformation of Work in the Electronic Age*, The Free Press a Division of Macmillan, Inc., New York, 1985.

BIBLIOGRAPHY

Baroudi, J.J. and Orlikowski, W.J., "The Problem of Statistical Power in MIS Research," MIS Quarterly, Vol. 13, No. 1, March 1989, pp. 87-106.

Bentler, P.M., "Simultaneous Equation Systems as Moment Structure Models," Journal of Econometrics, Vol. 22, 1983, pp. 13-42.

Bentler, P.M., "Multivariate Analysis with Latent Variables: Causal Modeling," Ann. Rev. Psychology, Vol. 18, 1980, pp. 419-456.

Bentler, P.M., "Some Contributions to Efficient Statistics in Structural Models: Specification and Estimation of Moment Structures," Psychometrika, Vol. 48, No. 4, December 1983, pp. 493-516.

Composite Health Care System (CHCS), Hospital Systems, Program Fact Book, Defense Medical Support Center, January 1990, pp. D1-D6.

Muthen, B., "A General Structural Equation Model with Dichotomous, Order Categorical and Continuous Latent Variable Indicators," Psychometrika, Vol. 49, No. 1, March 1984, pp. 115-132.

United States General Accounting Office, Report to the Chairmen, Senate and House Committees on Armed Services, Medical ADP Systems, "Changes in Composite Health Care System's Deployment Strategy Are Unwise" GAO/IMTEC-91-47, September 1991.

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Thesis
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c.1 Evaluation of a user
information satisfaction
short-form instrument.